AMERICAN ENGINEER
CAR BUILDER AND RAILROAD JOURNAL.

JANUARY, 1897.

CONTENTS.

ILLUSTRATED ARTICLES:	Page.
Altoona Shops of the Pennsylvania Road	1
Double-End Side Tank Locomotive for Japan	5
An Automatic Indicator on the Western Railroad of France	5
Coal Handling Machinery at the yard of J. T. Story, Brooklyn	15
Construction and Maintenance of Railway Car Equipment	26
Ten-Wheeled Locomotive for Lake Shore & Michigan Southern Ry	33
A Powerful Cold Metal Saw	35
EDITORIALS:	
The Right to Manufacture Coupler Knuckles for Repairs	18
The Decimal Gage	18
The Movement for a Standard Box Car	18
The M. C. B. and M. M. Conventions	18
Selection of Subjects for the Master Mechanics' Convention.	19
Water-Tube Boilers	19
The Engineer in Naval Warfare	19
Defects and Improvements in Locomotives	21
The Training Which Apprentices Need	23
MISCELLANEOUS:	
The Operating Mechanism of the Rock Island Bridge	4
The Richmond Compound Locomotive	5
Report of the Secretary of the Navy	9
Electricity on the N. Y., N. H. & H. R. R.	9

MISCELLANEOUS.	Page.
A Horseless Road Carriage Competition	10
Piece Work in Repair Shops	10
Electric Motors on the Brooklyn Bridge	10
Proceedings of the American Society of Mechanical Engineers	11
Railways and Car Building in Japan	14
Thornycroft Water Tube Boilers for the New U. S. Torpedo Boats	14
Canadian Society of Civil Engineers	14
Construction and Condition of Mail Cars	17
Engineering Notes	24
Shall the Cubic Capacity of Box Cars be Increased?	28
Progress in the Manufacture of Iron and Steel in America, and the Relation of the Engineer to it	29
Personals	31
David Leonard Barnes	32
Court Decision on the Manufacture of Parts of Pressed Steel Car Trucks	33
Decision on Right to Make Coupler Knuckles for Repairs	34
National Association of Manufacturers	36
Dixon's Water-proof Graphite Grease for Signal Work	36
Air Lift System of Pumping	36
Equipment and Manufacturing Notes	37
Our Directory	38

THE ALTOONA SHOPS OF THE PENNSYLVANIA RAILROAD.

VII.

(*Continued from page* 320, *Vol. LXX.*)

The reader of these articles has learned before he has reached this one that no systematic arrangement of them or the subject they embrace has been aimed at. They have merely been somewhat full reports made from notes of personal observation and investigation. No introductory remarks are therefore needed for the following description of

VULCANIZED GRAPHITE BEARINGS.

One of the novelties in the shops is the use of this material in the bearings of connecting-rods and in engine-truck boxes. Vulcanized graphite is substantially what is known as vulcanized fiber impregnated with powdered graphite or plumbago. In applying it to bearings, a groove is planed in the brass longitudinally to the journal. Thus in the bearings for a journal 5½ inches diameter, two grooves each 1 inch wide and ⅜ inch deep, were slotted transversely in the bearing and longitudinally to the axis of the journal. These are made slightly dove-tailed so as to hold the fiber in position. It is made in sheets ¼ inch thick, and it is found that it wears better if the pieces put into the journal are placed so that the wear will come endwise to the material or on its edge as it is made. Two thicknesses of it are therefore drawn into each groove from its end. The report is that it wears much better than babbitt, and is in every way more satisfactory.

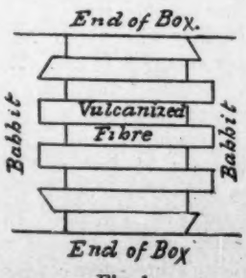


Fig. 1.

For truck boxes the fiber is cut into strips 2 inches long by 1¼ inches wide and ¼ inch thick. These are placed as shown in Fig. 1, which is an inverted plan of the bearing. Babbitt is then cast in the box so as to fill the space on each side of the fiber and conform to the journal. A box was shown which had been so hot as to melt the babbitt, but the fiber was still intact. Very excellent reports are given of the working of this material. It is made by the Vulcanized Fiber Company of Wilmington, Del.

KINDLING LOCOMOTIVE FIRES WITH OIL.

In the engine-houses at Altoona the oil fire-kindling apparatus and process is generally used for lighting the fires in locomotives. The apparatus consists of a portable cylindrical tank or reservoir, which holds a gallon and a half of crude oil. A force pump is attached to the inside of this, and a rubber hose with a flat nozzle is connected to it. The nozzle is made of a piece of ¼-inch gas pipe a few feet long, with its end flattened to form the nozzle. Before kindling the fire a layer of coal about 8 inches thick is spread over the grate and a few bunches of greasy waste is laid on top. The oil is then sprayed over the surface of the coal by the force pump attached to the reservoir, and the waste is then lighted. The engine-houses are now provided with steam pipes which run all around the outside, and from which branches lead down to an underground connection alongside of the engine pits. The blower pipes on the locomotives also have a screw connection on the outside of the smoke boxes. A hose is connected to the steam pipe underground, and to the blower pipe. After the waste and oil have been burning for about ten minutes steam is turned on to the blower, which of course acts on the fire so as to raise steam in from 50 to 60 minutes. In urgent cases sufficient steam has been raised to run an engine out of the house and on to the turntable in 28 minutes; but it is not considered advisable to do it so quickly. The steam pipes have a connection leading into the pits, so that any accumulation of water in them can be blown out before steam is turned on to the blower.

CLEANING FLUES WITH COMPRESSED AIR.

Among the many uses to which compressed air is applied in these shops is that of cleaning flues. To do this a piece of ¼-inch gas pipe about 10 feet long is used, which is attached to a rubber hose with a stop-cock between them to turn on and shut off the the air. If, when the flues are cleaned, the engine has steam on, the rubber hose is attached by an ordinary brake coupling to the brake pipes in the tender. The airbrake pump is then started which furnishes the supply of compressed air which is needed. The gas pipe is inserted through the furnace-door and the current of compressed air quickly removes the soot and ashes inside of them. It is thought that if a piece of pipe long enough to reach nearly to the front ends of the tubes is used that they are cleaned more thoroughly than they are with one which will extend only a short distance into them. To handle so long a pipe, however, it is necessary to disconnect the engine from the tender, which consumes time and labor, and therefore the shorter pipe is employed.

CARE OF ENGINE LANTERNS, ETC.

A very considerable expense was formerly incurred on this road in supplying engines with red and white lanterns, torches, oil-cans, monkey-wrenches, etc. These would be broken, or lost, or destroyed. The plan was, therefore, adopted in the engine-houses at Altoona of supplying each engineer with these equipments and holding him individually responsible for them. With this object in view a room and attendant was provided for storing and checking these articles; and whenever a man has completed his run he is required to check them in this depository. He alone, therefore, becomes responsible for them, and if they are injured or lost he can be called to account and any undue carelessness or neglect is counted against him. The result of the introduction of this system was a greatly reduced cost for such supplies.

NEW BLACKSMITH SHOP.

One of the new, or, it might be said, the only extension of the shops in Altoona, which has been made recently is a new smith shop, which has just been occupied. It is 223 feet 8 inches by 68 feet and 20 feet high to the roof truss. It has 25 forges, a number of heating furnaces for bolts and similar work, two shears and punches, three bolt machines and a "bulldozer." The equipment is not yet all in the shop, but, when completed, it will form an important addition to this great establishment.

CAR SHOPS.

The general arrangement of the car shops of the Pennsylvania Railroad at Altoona is shown in the plan which was published in our June number. They are located along the main line of the railroad, which runs in an easterly and westerly direction through the city of Altoona, part of which is on the north and part on the south side of the railroad. For the convenience and safety of foot passengers a foot bridge has been built across the railroad and extending over the grounds occupied by the car shops. The view, which was also published in the June number, was taken from the bridge, and gives an idea of the appearance of the buildings and grounds, but even the faithfulness of photography does not show the scrupulous "good order" in which the buildings and their surroundings are kept. Many of the parts of cars when completed are piled outside of the shops, and the care and regularity in which they are arranged can be compared only to that which military men practice in arranging shot, guns and stores in arsenals and fortresses.

The grounds of the shops here described are kept clean and orderly and in the west end, when it was practicable, there was an example of landscape gardening of no mean pretensions and of very pleasing appearance. To show how far the spirit and practice of order is carried, in entering near the office the visitor may notice several cars for the reception of various waste products. One of them is for turnings, which was divided into three compartments, each lettered distinctly one for iron turnings, another cast-iron borings and a third steel turnings, the purpose being to keep all them separate and thus increase their value either for sale or re-use.

The first shop visited was the freight, repair and erecting shop, which is an enormous round-house 433½ feet in diameter outside, having an open space inside with a 100-foot turn-table in the center. There are thirty-eight tracks or stalls with pits between the rails, each track of sufficient length to be occupied by two cars under construction or repair. There has been much criticism of the adaptation of this plan of shop for the purpose for which it is used. On inquiry of the foreman, Mr. Andrew Kipple, he reports that his experience leads him to approve of the plan for a car-repair or erecting shop, that it facilitates the handling of the cars by a switching engine and the turn-table which is operated by steam power, and that the radial position of the tracks on which the work is done gives ample room on the outer portion of the building, where the tracks diverge, for work benches, the temporary storage of material, etc.

In these shops, as in all the others at Altoona, the system of piece work is generally adopted, which was described in our December number.

Comparatively little new work is in progress in any of the departments of the car works. An order for 75 refrigerator cars for carrying dairy products was being executed at the time of our visit. These are 36 feet long over the bodies, have Janney couplers and air-brakes. The sides are filled with heavy hair felt, covered with two layers of brown paper. Three furniture cars are also in progress, which have very large bodies to give as much storage-room as possible.

All the heavy parts of the cars are stored out of doors, but the space occupied by two tracks is devoted to the smaller parts, and those which would be injured by the weather. The material for each job is selected and loaded on cars or trucks run on the turn-table and then delivered to the track on which the job for which the material is intended is in progress.

Some idea of the amount of the car-repair work done in Altoona may be formed when it is said that at the present dull times about 300 cars are repaired daily. Those needing only slight repairs are overhauled in the new yards east of the car works, which is a sort of immense temporary hospital for invalid rolling stock.

TRUCK SHOPS.

A shop which, compared with some of the others is small, being only 85 by 87 feet, is devoted exclusively to the assembling and erection of car trucks. The building is isolated, and is thus admirably lighted on all sides. The axles used here are turned and the wheels are bored in another shop. Most of the other machine work is, however, done in the building here described. The standard freight truck used by the Pennsylvania Railroad is of the "diamond" pattern with channel-bar transoms. The holes in the arch bars for the truck sides, are drilled by two multiple drills each with eight spindles and another double drill bores the holes in the spring seats. A somewhat unusual machine, built by Wm. Sellers & Co., is used for drilling the flanges of the channel bars. The 18 spindles and drills of this machine work horizontally, in two rows, opposite to each other. The channel bar is placed between the two rows, with the flanges up, so that all the 18 holes in the two opposite flanges are drilled at the same time. Another vertical upright machine drills and countersinks eight holes in the web or plate of the channel bar. When the holes are all drilled the castings, etc., which are attached to each separate bar are riveted to it in a stationary hydraulic riveter. When this is to be done they are placed on two cast-iron stands made for the purpose and fastened to the floor the proper distance apart and of a certain height for doing the work. The castings and attachments which are riveted to the two bars are then put into position and riveted by a portable hydraulic machine. Four pairs of the cast-iron stands are provided, and the hydraulic riveter is carried by a traveling crane which has about 12 feet span. With this the riveter can be placed in any position over any of the four pair of stands.

A grinding machine which was new to the writer is used for grinding the cover-seats of the journal boxes. It consists of a shaft on each end of which is a cylindrical head or disc about 8 inches diameter which carries three emery "plugs." These are cylinders of emery 1¼ inches diameter by 3¼ inches long. These are fastened by a sort of cam device, analogous in its action to that of a scroll chuck, and are clamped fast so as to project a short distance from the face of the disc. The journal-box is placed into a position in front of the disc which brings the cover-seat parallel to the face of the revolving disc. The box is carried in a suitable sliding head and by a feeding arrangement the seat can be brought up in contact with the emery "plugs" and can be fed crosswise or parallel to their planes of revolution. By this means the seats are quickly ground to a true surface. Pressed-steel box covers are used. A Sellers tool grinder, a double spindle drill, several drill presses and other ordinary tools complete the equipment. Wooden bolsters are used in the trucks here described. These bolsters rest on two nests, each of four coils of spiral springs, 5 inches in diameter and made of 1-inch round steel. The seats and caps of the nests are made of pressed steel.

The trucks are assembled on a track which runs through the middle of the shop, the rails being elevated somewhat above the floor so as to bring the parts to a more convenient height for the workmen. Twelve men will put together 40 trucks in 10 hours.

PASSENGER-CAR SHOP.

The passenger-car erecting shop has five tracks parallel to each other with room for three cars on each. One of these is used for bringing in the material. At present the only new work in progress is an order for 19 new coaches; seven of these are to have vestibules. These are of a new design, the object of which was to reduce the weight of the car as much as possible, without any reduction in strength. It is expected that they will weigh 7,000 pounds less than the standard passenger cars now in use. The new cars are to seat 64 or 66 passengers. Some of them are to have stoves as an auxiliary means of heating, and these will seat only 64 passengers. All of them are to be equipped with steam heating appliances. The length of body is 54 feet and its width 9 feet 8¾ inches over frames. The outside and center sills are 5 by 8 inches, and the intermediate 4½ by 7½ inches. The platforms have been designed especially with reference to strength, and they are equipped with Buhoup's three-stem coupler, with a Janney head. The platforms are provided with buffer-plates attached to double-stem spring buffers.

The outside of the cars instead of being paneled are sheathed with vertical strips ⅞ inches thick and 2 inches wide. A feature which has been introduced in many places is to groove the rails, truss-planks and some of the panels with a number of longitudinal

grooves. These are ⅜ inch wide by ⅜ inch deep, the bottoms being round. The truss-plank, for example, is 1¼ by 8¼ inches and grooved on the back. The top plate, instead of consisting of a single piece on top of the posts, is made of two pieces ⅞ by 9 inches attached to each side of the posts, both grooved on the inside. This arrangement leaves room so that the window sash can raise up between them. The letter-board on the outside is ⅞ by 11½ inches, and is also grooved inside. The upper window belt rail is 1¼ by 4½ inches. The outside window capping is made of walnut, and both are grooved. The flooring of some of the cars consists of a single longitudinal floor 1¼ inches thick. Some of the others will be made of two thicknesses, each ⅝ inch thick, the top one being of maple.

The vestibuled cars will have two water closets, but those without vestibules will have only one. Formerly the clear story rested on a longitudinal piece of oak, 4½ by 4⅝ inches. In the present cars the lower rail of the clear story is made of a piece of white pine, 5½ by 2⅜ inches. The mullions are also white pine and covered with thin oak on the inside.

The wooden truck sides are reinforced with ¼-inch steel plates on the inside. Wooden safety timbers have been abandoned and iron substituted in their place. A steel spring plank has also been used instead of a wooden one. The brakes are hung on the inside or between the wheels, instead of outside, as has been the practice heretofore. The axle journals are 4 by 8 inches. The body bolsters consist of two trusses made of bars 6 by ¾ inch placed 36 inches apart from center to center, the two being connected together at the center to receive the center plate. The ends of the roofs which project over the platforms are rounded. The spaces between the floors are filled with mineral wool.

The window sashes are hung and fastened on the system of O. M. Edwards, of Syracuse, N. Y., which is new and apparently a great improvement on the ordinary method. As all travelers know to their discomfort, car windows seldom work satisfactorily. Recently we had occasion to criticise the window latches used on some of the cars of the Pennsylvania road, and the advisability of carrying a small "jimmy" for prying windows open on railroad journeys has also been suggested. In dry weather car windows are prone to rattle, and in wet weather they swell and resist the most strenuous efforts to open them. Most car windows, too, have not a sufficient number of stops to hold them up. The passenger must either be content to have the window closed or entirely open. Usually it cannot be held up a short distance only.

By the Edwards system the sashes are fitted loosely in the grooves in the post, and the sash is balanced by a coiled spring above it inside of the car sheathing, or more specifically, inside of the letter board. Long flat springs are attached to the window facings, and bear against the sides of the window sash. A double latch is attached to the middle of the window sill and is connected with the sash springs in such a way that when the two latches are compressed, the pressure of the sash springs is withdrawn from the sash and it is then entirely free to move. As it is somewhat overbalanced by the spiral spring, the sash raises of itself, when the latches are compressed, and is held in any position it may be in, when they are released, and the side springs then press against it. Altogether, it seems to be the most complete and convenient sash fixture that has thus far been devised.

On all of their day coaches the Pennsylvania Railroad authorities have adhered to the old-fashioned Venetian blinds for the windows. On the new cars here described curtains have been substituted for the blinds. The curtains are held in position by the fastening made by Forsyth Bros. & Company, of Chicago. The lower edge of the curtain is attached to a rod or tube with slides on each side which move in grooves in the window posts. At the middle of the rod is a double latch connected to the slides in some way, so that when the latches are compressed the slides are free to move in the grooves, and when the latches are released the slides are clamped and hold the curtain in any position in which it may be placed. The curtain rolls on a usual form of spring roller. Altogether the window and curtain fastenings are the most convenient and elegant that have thus far been put in cars. The blinds were discarded to save weight in the cars. The objection to curtains is that they soon get so much soiled as to be very objectionable. Some which the writer recently saw on a car of a New England railroad were extremely obnoxious by reason of the dirt and wear to which they were exposed. The abandonment of the more cleanly window blind is to be regretted.

Some of these cars are to be finished in hazelwood, others in oak, and still others in baywood. The bulkheads at the end of the car have each a very neatly designed and constructed brass grill which the Pennsylvania road has made a feature in the finish of its more recent cars. The ceilings are covered with straw-board which has been molded or stamped with shallow indentations approximating to a checker-board pattern, and painted what ladies would probably call a "crushed raspberry" color, with moldings dividing it into a number of medium-sized panels. The wood and the color of the ceiling with the uneven surface of the straw-board gives a very pleasing effect, with an entire absence of the gaudiness and over-ornamentation characteristic of many cars.

The clear stories of these cars are made 10 inches wider than those in the standard passenger cars. The side-lights are glazed with stamped colored glass with bas-relief figures. The seats in one of the cars are covered with a somewhat peculiar figured material the name of which we did not learn; the others, we were told, would be covered with plush. At the time of our visit the cars had not been weighed, so the saving which has been effected cannot be definitely stated.

PLANING MILL.

This building is 355 by 72 feet and is equipped with woodworking machinery for doing a large amount of work. This consists of eight planers, two band-saws, four crosscut saws, three turning machines, five rip saws, four mortising machines, six boring machines, one shaper, one universal wood worker, one molding machine, a knife sharpener, two saw grummers, a crosscut automatic saw sharpener, another for band saws and two Sturtevant fans for carrying shavings and sawdust to the boiler room. A curious devise is used in connection with these fans. It was found in feeding the boilers with shavings that a considerable quantity was carried through the flues so quickly that they were not consumed but escaped from the chimney and thus were the cause of danger from fire. To obviate this strips of iron 2½ inches wide—equal to the inside diameter of the tubes—and ¼ inches thick were twisted and inserted in the tubes. This compelled the gases, sparks and unconsumed shavings to pass through the tubes in a spiral path, thus delaying their movement sufficiently to secure the complete combustion of the latter. It is also said that the evaporation and economy of the boiler to which the spiral plates have been applied has been materially improved. Six boilers of the locomotive type are used and the shop is driven by a 250 horse-power Corliss engine.

This shop, like all the others, is operated almost exclusively by the piece-work system. More than 1,000 different prices are needed to meet all the requirements of the work.

BLACKSMITH SHOP.

This building is 493 × 74 feet and has 96 forges and nine heating furnaces. It is equipped with seven steam hammers, a number 0, a number 1½ and a number 7 Hillis & Jones punches and shears. The latter will cut a cold bar of iron 4½ inches square and three punches are often used in it in a gang to punch holes 1½, 2 and 2½ inches diameter at one time. Nine smaller punches are also often used in a gang to punch that number of holes through 1-inch bars at once. Besides these machines there are two vertical and two alligator shears, one Burdick 2-inch bolt machine, one Blakeslee's number 7 forging machine, which weighs 63,000 pounds, five belt hammers, two Blakeslee number 5 "bulldozers" and one Pratt & Whitney drop hammer. The power for driving the shop is provided by a 70 horse-power horizontal slide-valve engine at one end of the shop and a vertical engine at the other.

The interesting feature in this shop, which it would take a great deal more time and space to describe than can now be given to it, is the various kinds of dies, bending appliances and tools of vari-

ous kinds which have been devised for doing the great variety of work which is now used on cars. This variety has been greatly increased by the introduction of automatic couplers, air-brakes, spring-buffers and steam heating, and many of the parts now used for these appliances are of much greater complexity than those which were employed in the earlier days of railroading. This and the necessity of reducing the cost of manufacture has made it necessary to devise a great variety of appliances for doing work. The system of piece-work has also stimulated the ingenuity of the workmen to devise means which would expedite the operations they have to perform. The result is that a great variety of small tools of various kinds have been provided, which all help to diminish the cost of labor and the time required to do work. Nearly all the work is done by the piece, and the same testimony was given here as in the other shops, which was to the effect that the cost of turning out work is reduced from 50 to 75 per cent. and the output more than doubled by the piece-work system.

A very interesting book could be made if any competent person could give the time to describe and illustrate in full detail the methods and special tools and machines which are here employed. It would be impossible to explain these so that the explanation would be intelligible without elaborate illustrations, the making of which would be a formidable undertaking. One illustration of a method of saving work may be given. A brake lever is a flat bar of iron with its fulcrum nearer to one end than to the other, and tapering from the fulcrum both ways. Formerly these were drawn out to a tapered form under a hammer which required considerable time and labor. To lessen this the bars of iron are now rolled into the tapered form—a half dozen or more levers in one bar—so that all that is required is to cut them off at the right place, and of the right length, and then shear off the ends round and drill or punch the holes for the bolts. All these operations are performed almost as rapidly as the levers can be handled and counted.

Some time since an accident happened from a brakeman twisting off a brake shaft, which was badly welded, and he was thrown from a car and killed. It should be said that the brake shaft used on the Pennsylvania Railroad is about five or six feet long and 1⅛ inches in diameter at the lower part, a square place about the middle, 1¼ inches on a side, and the upper end is drawn out round to 1¼ diameter. A die is now used for doing this which draws down the bar to the required size and facilitates the making of the square part without removing it from under the hammer. The shaft is thus made out of one piece and there is then no danger of breakage from a bad weld.

The iron which is intended for use in the shops is stored in racks or bins outside of the two ends of the building. Each of these bins is numbered and a card is assigned to each bin in which the iron received and that given out is entered. From this the amount on hand can be made out at any time, which should, of course, correspond with an inventory whenever it is taken. The cards are in charge of a person whose business it is to look after the stock of iron on hand, and they are stored in a case under lock and key in the engine-room.

The truck shop, which has been described, is near the blacksmith shop. When the trucks are completed, they are run out on a track alongside of the smith shop to be oiled. By the repetition of this operation, on many trucks, much oil was spilled in the ground, which thus became saturated with it. It was therefore feared that it might take fire if a piece of hot iron or a light should accidentally be applied to it. To obviate this risk, a series of sheet iron pans have been located alongside of the tracks, into which the oil drips, and from which it is readily removed.

An air hoist for loading and unloading trucks, to and from cars, is located near this place. It consists of a "gallows" frame made of wood, the top horizontal beam being trussed. A vertical air cylinder is suspended from a trolley which runs in a track on top of the horizontal beam. The cylinder has a piston and rod of the usual kind, the latter with a set of suitable hooks at its lower end to attach to a truck. Rubber hose conducts the compressed air to the cylinder. The trolley is moved transversely by means of a chain and windlass, the latter connected to one of the posts of the frame. The celerity of action of this saves much time and labor.

MACHINE SHOP.

The machine shop for doing iron work such as turning axles, boring wheels, drilling, etc., is a building 132 feet by 70 feet. It contains twelve axle lathes, four wheel-boring machines, two wheel-presses for putting on wheels and one for removing old wheels, a car-wheel grinding machine, one slotting machine, one machine for straightening axles, four lathes for miscellaneous work, one shaping machine, fifteen drill-presses, three planers and two bolt thread-cutting machines. The shop is driven by a 100-horse power compound engine. It also drives a dynamo and two Westinghouse brake pumps for compressing air for pneumatic hoists. A number of these appliances are used in the shop for handling wheels, axles, etc. The shop has capacity for turning out 100 pairs of wheels and axles per day.

One of the novelties in this shop was a burnisher for car-axle journals represented by the engraving, Fig. 2, herewith. It consists of a hardened steel cylindrical disk *A*, 4 inches in diameter and ¼ inch wide, one corner of which is rounded with a radius of ⅜ inch. The disk is carried in a forked holder as shown. This is put into the ordinary tool-holder of an axle lathe in which the axle is revolved at a speed of 500 revolutions per minute. The steel disk is then screwed hard against the journal and revolves with it. At the same time it is fed longitudinally toward the rounded corner. The effect is to condense and solidify the surface of the journal and give it a much better wearing surface than it would have if it was not burnished. It has been used to a very considerable extent with excellent results. It was devised by Mr. John H. Hindman, foreman of the shop.

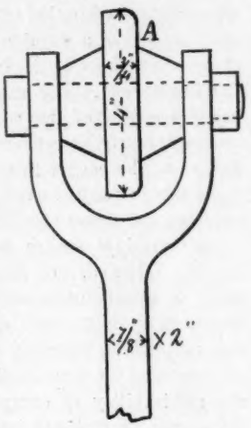


Fig. 2.

Many of the wheels used in passenger service are ground on their treads, especially those wheels which are cast in contracting chills. The slightly uneven surface of the tread, which is left by this kind of chill, causes the wheel to make a sort of whirring sound in running on the track. The grinding overcomes this objectionable sound.

THE CABINET SHOP.

This is 75 by 160 feet and is equipped with the usual machinery found in such establishments. It is admirably lighted and arranged and is capable of turning out a large amount of work.

THE TIN, TRIMMING AND UPHOLSTERY SHOPS.

These departments are housed in a building 200 by 75 feet, which gives ample room and light. The upholstery department is in a loft at one end of the building.

(To be Continued.)

The Operating Mechanism of the New Rock Island Bridge.—A Correction.

In describing last month the operating mechanism of the Rock Island Bridge we reproduced a diagram of end jacks which we stated showed the construction of those in use on that bridge. We should have stated that the particular jacks shown were designed for a much smaller and lighter bridge and the engraving was only introduced to illustrate the general type of jack in its elementary form. The few dimensions given on the cut would indicate that a mistake had been made, but that no injustice may be done Mr. Modjeski or Messrs. G. P. Nichols & Brother, we make this correction.

Double-End Side Tank Locomotive for Japan—Brooks Locomotive Works.

Through the courtesy of the Brooks Locomotive Works we present herewith a photograph of one of the two engines they have just shipped to Japan. As will be seen, the engines have six-coupled wheeled, a two-wheeled radial leading track and a two-wheeled trailing truck also. The water tanks are on each side of the boiler and the general finish of the cab, dome and sand-box casings, stacks, etc., suggest European practice.

The gage of the road is 3 feet 6 inches. The cylinders are 15 inches in diameter by 22 inches stroke, and the driving-wheels are 48 inches in diameter. The boiler is straight and is 54 inches in diameter. It is of steel $\frac{7}{16}$ and $\frac{1}{2}$ inch thick and carries a pressure of 150 pounds. The firebox is also of steel and is 78 inches long and 29 inches wide inside of the ring. It is stayed by 1-inch radial stays. The tubes are of brass No. 14 B. W. G., $1\frac{3}{4}$ inches in diameter and $9\frac{1}{2}$ inches long, and there are 210 of them. The total heating surface of the boiler, is about 950 square feet.

Double-End Side-Tank Locomotive for Japan. Built by Brooks Locomotive Works.

The driving-wheel base of the engine is 10 feet 4 inches and the total wheel base 23 feet 8 inches. The weight on the drivers is 78,000 pounds, and on each truck 11,000 pounds, making a total of 100,000 pounds. This is with 1,200 gallons of water in the tanks and one long ton of coal in the coal-box at the rear of the cab.

In most respects the details are American. We notice several departures, however, such as a copper dry pipe and headlights and signal lamps of the Japanese standard. The couplings and buffers are English. The truck wheels are steel-tired and 26 inches in diameter. All axles and rods are of hammered iron. The cylinders and boilers are lagged with asbestos board. The cylinder casings are steel, as is also the steam chest cover casing. The smokestack is of iron with a copper top. The cab is of steel. The engine is equipped with the Le Chatelier water brake and steam and hand brakes on all drivers. The injectors are Sellers No. 7, and the rod packing is United States metallic.

The Richmond Compound Locomotive.

The "tramp" Compound of the Richmond Locomotive Works last month finished a service test on the Louisville & Nashville Railway and went to the Wabash at once for experimental runs between St. Louis and Decatur, which will be watched with interest. The Louisville & Nashville Railway has made no report yet, but it is understood that the engine has given perfect satisfaction and showed great fuel economy.

An Automatic Indicator on the Western Railroad of France.*

BY M. E. BRILLE,

Inspector of Material and Traction of the Western Railroad.

In order to obtain indicator diagrams from locomotives, a more expensive installation is required than in stationary practice, as independent of the apparatus for transmitting motion (mechanism often found to be delicate), there is the box and hand rails for the protection of the operator. M. Clerault, Chief Engineer of the Material and Traction of the Western Railroad of France, has thought that a gear could be constructed which had no mechanical connection with the crossheads, and with which the diagrams could be taken automatically without the presence of the operator at the front end of the locomotive. The apparatus which we illustrate herewith has been designed by M. Dubois, Assistant Engineer of Surveys, and by the author; it was constructed by the firm of Digeon from drawings furnished by the railroad company.

The mechanism employs an indicator for drawing the diagrams, but instead of making ordinary closed cards, it registers the pressures upon a drum which moves forward with a continuous motion during the tracing of a line, so that the curves approximate a sinusoidal shape. A chronograph records the dead points in the piston stroke. All this is done automatically, as well as the feeding of the roll of paper, the apparatus being started by a pull on a cord and automatically stopping itself when a cycle of operations is complete. The drum does not move with a speed exactly proportional to the speed of the piston at each point of the stroke, but has a uniform speed when in motion; that speed is, however, exactly proportional to the number of revolutions of the locomotive. The apparatus has no mechanical connection with the crosshead, as will be clear from the description of the details.

Fig. 1 gives the method of applying the apparatus to the locomotives; Figs. 2 and 3 are views of the apparatus itself; Figs. 4, 5 and 6 are sections of the distributing valve; Figs. 7 and 8 shows details of the drum mechanism, and Figs. 9 and 10 are examples of diagrams by the automatic and the ordinary indicator.

Before going into details it will help to make the description clear to say that all the lines of a single diagram are not taken during one and the same revolution of the locomotive; on the contrary, the pressure line for one end of the cylinder is drawn for nearly two revolutions as shown in Fig. 10, then the mechanism is put in communication with the other end of the cylinder and the process repeated, after which the steam-chest pressure card, exhaust passage card and atmospheric line are drawn by successive operations each following the other automatically without the attention of the operator.

The ends of the cylinder, the steam chest and the exhaust pas-

*An article with this caption appeared in the *Revue Generale des Chemins de Fer* for September, 1893, which we have translated, re-written and condensed in the form here given.

AUTOMATIC INDICATOR ON THE WESTERN RAILROAD OF FRANCE.

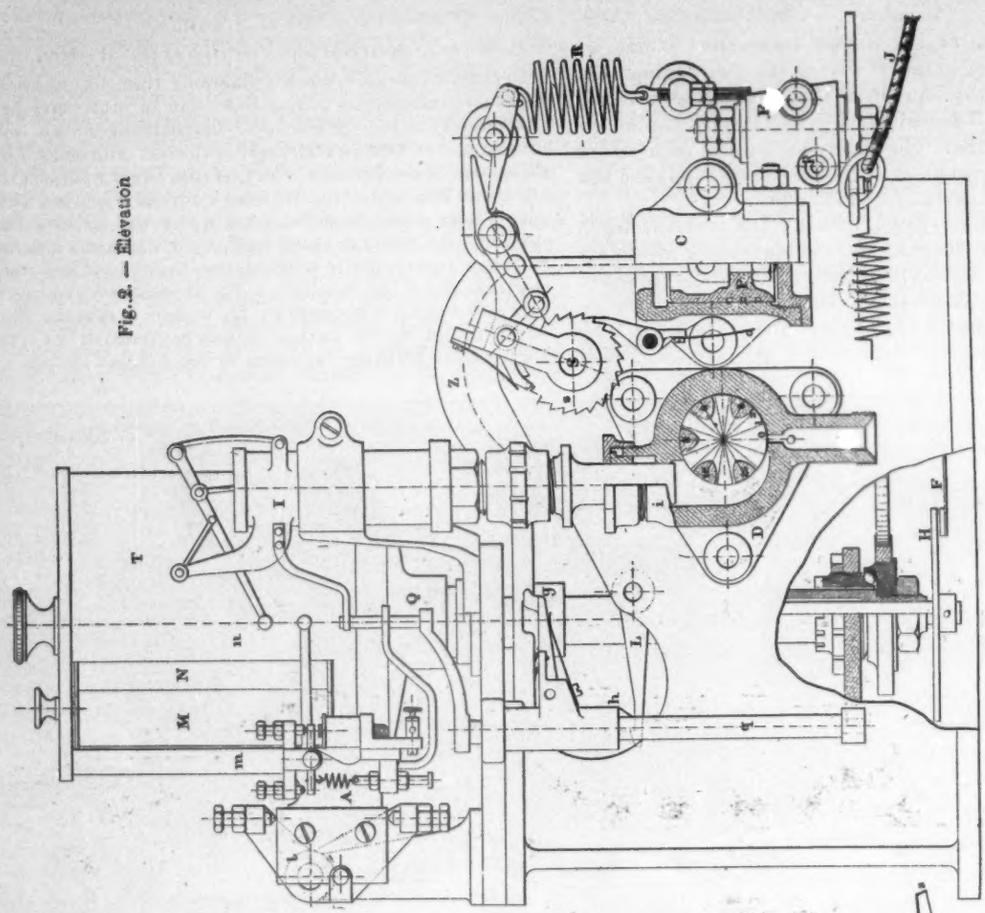


Fig. 2. — Elévation

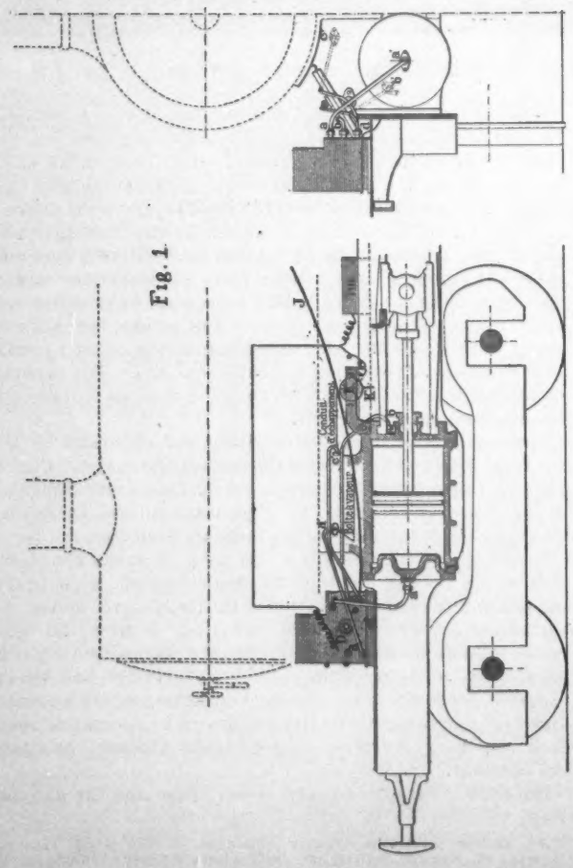


Fig. 1

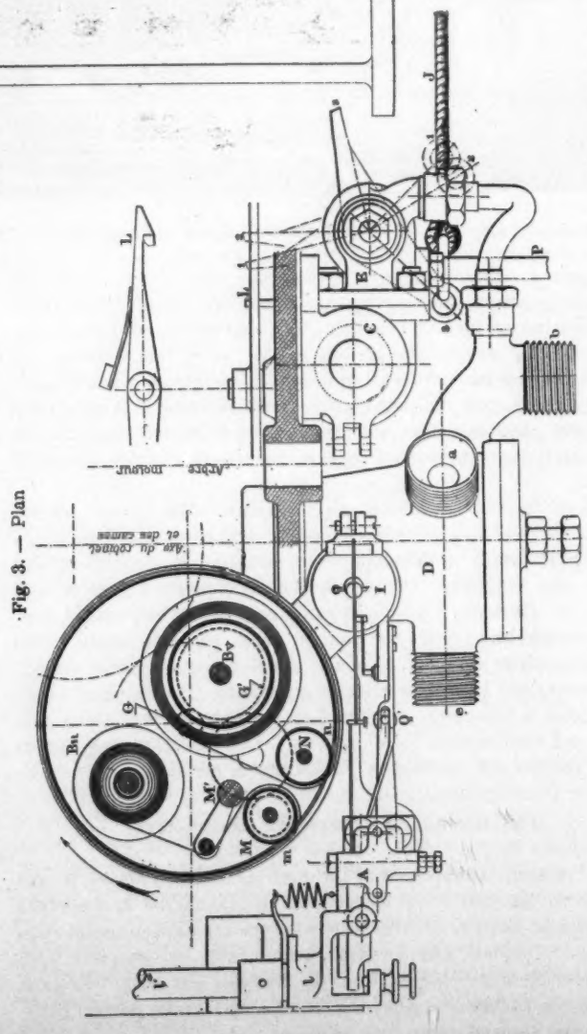


Fig. 3. — Plan

DETAILS OF AUTOMATIC INDICATOR ON THE WESTERN RAILROAD OF FRANCE.

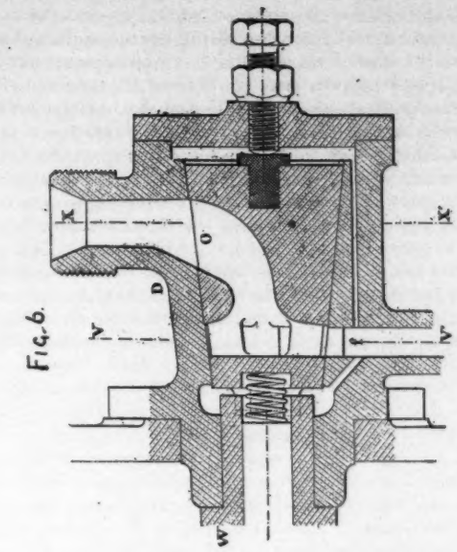


Fig. 6.

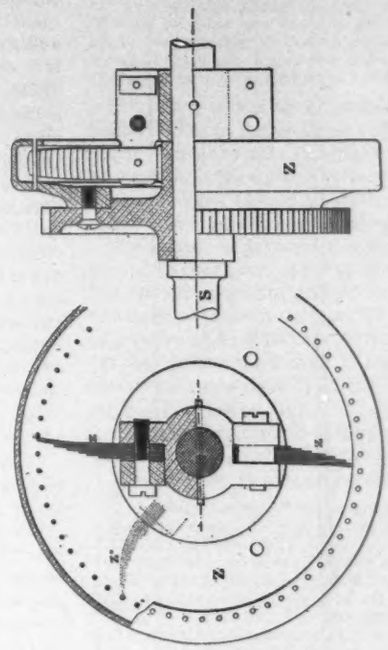


Fig. 8.

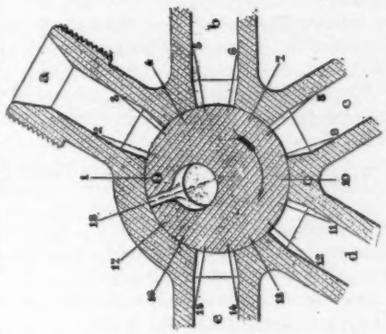


Fig. 5.-Section on X X'.

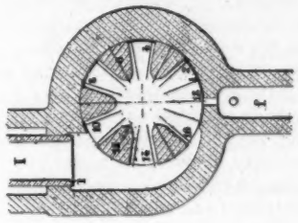
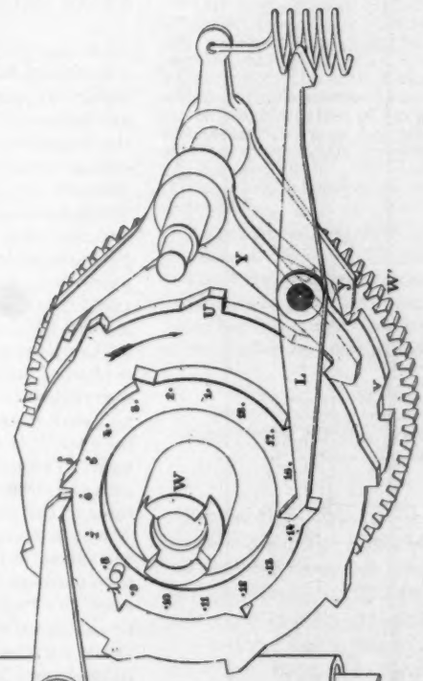


Fig. 4.-Section on V V'.



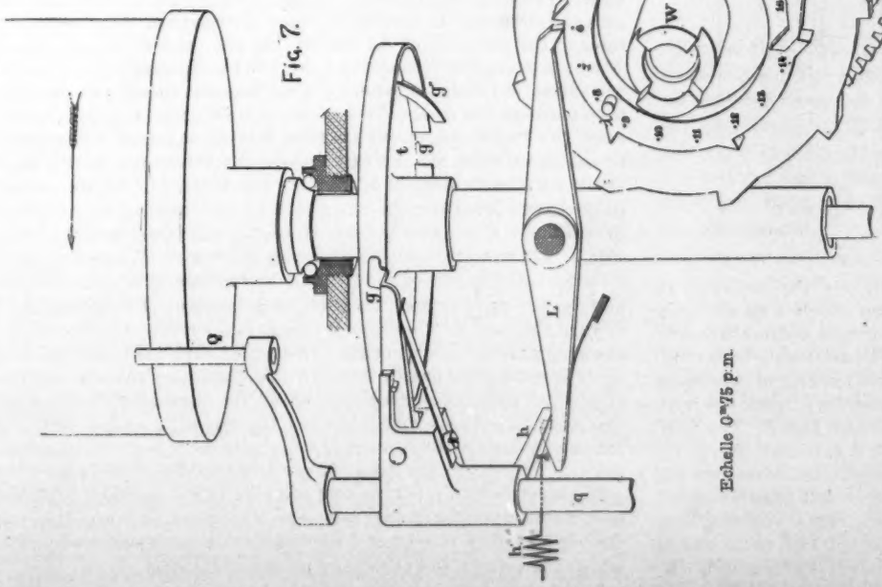


Fig. 7.

Echelle 0m75 p.m.

sage are all piped to the cock *D*, Figs. 2 and 3, and a port from the latter also connects with the atmosphere. A branch pipe from one of the cylinder pipes leads to the stop cock *E*. The latter is opened by a cord in the hands of the operator and has three positions; in the closed position all of the apparatus is idle; when pulled open as far as possible by means of the cord it connects the motor cylinder *C* with the steam cylinder of the locomotive, and also opens a port to the atmosphere; steam then blows through until all water of condensation is blown out, when the operator lets go of the cord and a spring partly closes the cock until its lever catches on the notch of the lever *L* (Fig. 3), where it remains until automatically released; in this third position the cylinder *C* is in connection with the locomotive cylinder, but not with the atmosphere, and its piston *P* makes a stroke for each stroke of the main piston, the admission pressure forcing the piston *P* up, and the spring *R* forcing it down as the pressure falls. The stroke of this piston is always great enough to turn the shaft *S* one notch of the ratchet-wheel *s*, and only one. This shaft has thus an intermittent motion, and from it are derived the movements of the remaining mechanism. These are chiefly two, the continuous rotation of the drum and the intermittent movement of the distributing valve. We will take up first the distributing valve.

This value *D* is seen in Figs. 2 and 3, and sections of it are also given in Figs. 4, 5 and 6. It is a plug cock with one port *O* in the plug, which registers successively with the passages *a*, *b*, *c*, *d*, *e* in the plane *X X'*, Fig. 6, as it is turned, these ports connecting with pipes leading from the ends of the locomotive cylinder, steam chest, exhaust passage and (if so desired) from the boiler. The plug also has a series of ports in the plane *V V'* (Fig. 6) which communicate, sometimes alternately and sometimes simultaneously, with the passage *l*, leading to the indicator, and the passage *f*, leading to the atmosphere. The plug is adjusted to a bearing by a set screw and is forced against that screw by a spring and by steam pressure on the small end, obtained from the passage *I*. The plug is turned by means of clutch faces on the end of it engaging with similar faces on the driver *W*, Fig. 6 (seen also in Fig. 7). It is evident that if this cock is

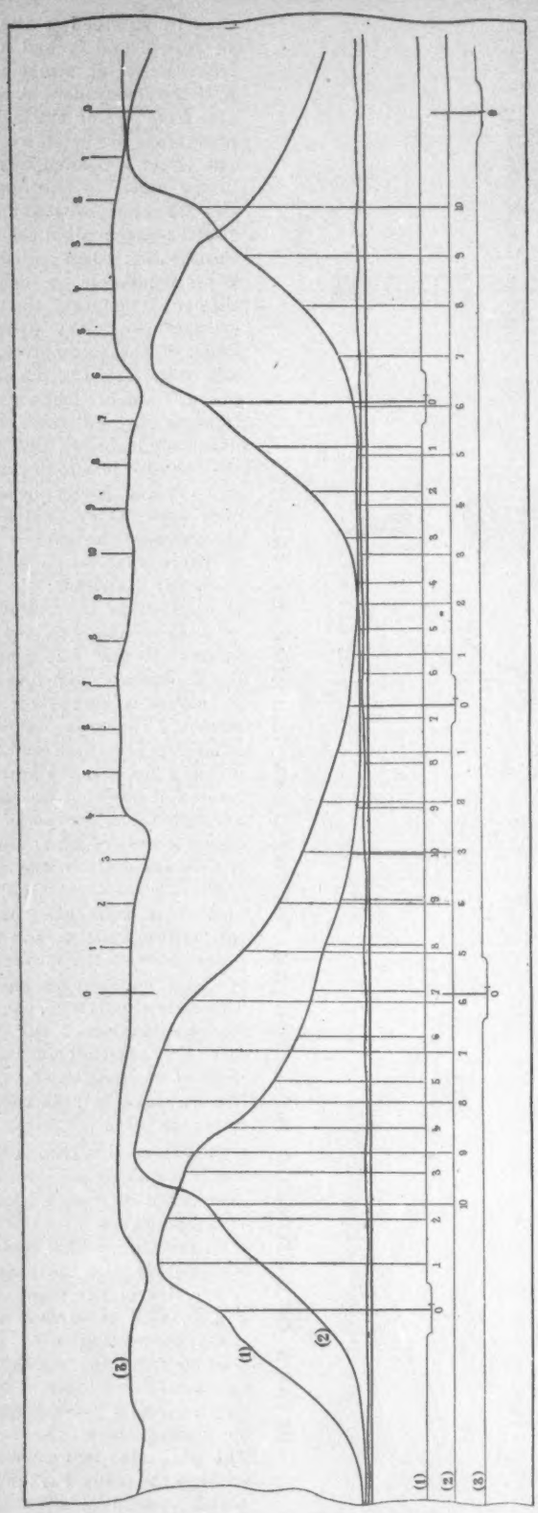


Fig. 9.—Diagram from Automatic Indicator.

rotated with an intermittent motion it will put the indicator in connection successively with the places from which a steam pressure record is desired. This rotation of the plug is accomplished by gearing from the motor shaft S and the 18 positions of the plug, marked in Figs. 4 and 5, are derived from the spacing of the teeth in the ratchet wheel S. Position 18 is the position of rest, the indicator being open to the atmosphere through the port f. The positions for taking cards are when the lines 3, 6, 9, 12 and 15 register with the port of f. It will be noticed from the lines indicating the other positions that each time the port f is closed it remains closed for nearly, but not quite, two whole positions (Fig. 4) and that during that time the indicator is in communication with some one of the ports a, b, c, d, e. This, as will be seen later, is to obtain a diagram covering nearly two revolutions.

The drum has a continuous motion obtained in an ingenious manner and illustrated in Fig. 8. On the motor shaft S is a loose gear carrying a ring Z, whose circumference is set with pins. Fixed to the shaft are two springs zz', the ends of which engage the pins mentioned. This gear drives the drum through intermediate shafts and gears. When the shaft S starts with its intermittent motion it at once takes a speed proportional to that of the engine. The drum, because of its inertia, cannot do this, and the springs deflect as shown at z'', even skipping from pin to pin until the drum gets up to speed. Then the springs by their elasticity permit the drum to revolve at a uniform speed, though driven from a shaft moving intermittently. Experiment has shown that during any single revolution of the drum its speed is constant, which is all that is required.

The paper for the drum is carried on the spool Bu inside of the drum (see Fig. 2), and passes over the roll M, thence around the outside of the drum, over the roll N, and onto the spool Bv. While the drum is revolving the paper is stationary on its surface until

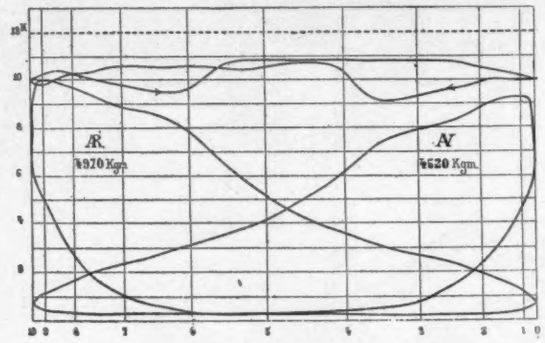


Fig. 10.—Indicator Diagram Corresponding to Automatic Card in Fig. 9.

the cycle of operations are practically complete, when the paper is shifted automatically. The gear G is on the upper end of a shaft passing up into the drum through the hollow spindle of the latter. On its lower end is a disk H, seen in Fig. 2. When the moment for changing the paper arrives, the brake F is brought into contact with the disk H and the motion of the shaft which had been carried around with the drum is arrested, the gear G standing still and the drum continuing to revolve the gear G' rolls over G and through the intermediate gear actuates the feed roll M, which take paper from Bu and roll up the used paper on Bv. The latter has a friction drive from the gear G' which keeps the paper tight. The roll Bu will hold from 10 to 15 meters of paper.

The diagrams are traced by metallic points, and the automatic control of both the indicator and chronograph tracing points is accomplished through the mechanism shown in Fig. 4. The ratchet and gear wheels U, V and W' are on the same axis as the distributor cock D, in fact, we have seen that the clutch face W rotates the cock. The motor shaft drives the gear W' which is loose upon its axis and connected to the ratchet wheel U by a spring which exerts its force in the direction of the arrow. The gear carries the cam wheel V which by means of the lever y rocks the escapement Y and permit the spring to rotate the wheel U a half space at a time. As there are nine teeth on the wheel U the movement each time is $\frac{1}{18}$ of a revolution. By this arrangement the cock D is moved from one position to another with speed and exactness. The other cam on the same shaft, with teeth marked δ, actuates the lever L'. In its normal position this lever engages the arm h of the vertical shaft q and prevents the upper arm Q from throwing the tracing points (see Fig. 2) into contact with the paper on the drum. When the lever L' is operated by one of the teeth δ it releases this shaft and the and the spring h' rotates the shaft, thus bringing the tracing points toward the paper. They do not immediately reach it, however, for the arm g prevents it by coming in contact with the rim of the disk t. It is not until g passes through the opening g' into the interior of the disk that the tracing points come into contact with the paper. The opening g' times with exactness the beginning of the card. The tracing points are thrown out of contact by the cam g'', which makes the arm g ride over the flange of the disk to the outside again.

The lever L (Fig. 4) is the same one seen in Fig. 3 which holds the cock E open until the cycle is complete. At the completion of the cycle the pin A strikes the lever L and causes it to release the cock E, which then closes and the entire mechanism stops.

The chronograph registers the ends of the piston stroke by means of an electric contact. It draws a straight line except that the

closing and opening of the circuit at the ends of the stroke cause an electro-magnet to pull down and then release the arm holding the tracing point, producing a "notch" in the line.

The character of the indicator and chronograph diagrams are shown in Fig. 10, and Fig. 9 is a corresponding diagram from the ordinary indicator. The diagram from the front end of the cylinder is distinguished from the one from the rear end by the fact that on it the dead points of the piston correspond with the points of admission, while on the other they occur in the period of exhaust. The chronograph records for each operation are placed one below the other for clearness. The chronograph record is not drawn during the operations of taking an exhaust passage card and drawing the atmospheric line. The "lag" in the electric apparatus has been determined for all conditions and tabulated so that the chronograph record can be quickly corrected for it.

The drum is so geared that it turns once for two revolutions of the drivers. Each diagram would thus represent two revolutions of the locomotive if it extended entirely around the drum. But the aperture occupied by the feed rolls prevents this and the tracing points are kept in contact for somewhat less than the two revolutions of the locomotive. The actual length of the diagram for one revolution of the drivers is 20 centimeters (about 7⅞ inches).

A complete cycle of operations by the automatic indicator takes place in 160 revolutions of the locomotive. Many of these revolutions take place during periods of exhaust from the indicator pipes or while the pipes are being blown out. Thus 50 revolutions takes place after the operator pulls the cord during which the apparatus automatically gets rid of the water of condensation, the drum gets up to regular speed, etc., and the last 32 revolutions of the 160 are employed in tracing the atmospheric line and changing the paper. From the beginning of tracing the first line of the card until all the lines are complete except the atmosperic line (in other words the two ends of the cylinder, the steam chest, exhaust passage and the boiler pressure line) the locomotive drivers make 74 revolutions.

It will be noticed that the uniform motion of the drum results in equal spaces on different parts of the diagram not representing equal displacements of the locomotive piston. This has the advantage of making the setting of the slide valve and the study of events near the end of the piston stroke more easy by these diagrams than by the ordinary ones, but to figure the power exerted by the engine the diagram must be redrawn into one of ordinary form. To do this a chart is employed by which the abcissas and ordinates of the one diagram can be readily converted into the other.

The apparatus has been in use some time and notwithstanding its apparent complication has done good work. It has been employed regularly by the department of material and traction of the Western Railroad for months, and records have been taken in all kinds weather, by day and by night, and on many different types of locomotives.

The Report of the Secretary of the Navy.

The annual report of Secretary Herbert asks Congress to authorize the construction of three more first-class battle-ships and twelve torpedo boats. He recommends that the battle-ships have an extreme deep load draft of only 23 feet, this draft being derived from considerations of strategy on the Atlantic and Gulf coasts. This is in line with the policy of the Navy Department fer some time past, but the reductions in the draft of recent ships has not been sufficient to accomplish the desired purpose, the last ships being of 2 feet less draft than the earlier ones, or 25 feet extreme. The first-class battle-ships already built are all right, but the necessity of having a part of the fleet of such draft as to freely enter the harbors of the Gulf is evident. The War College investigated this subject thoroughly and in its report said:

"The close study of the Gulf of Mexico which has been carried on by the Department's orders during the last year shows it to be essential to the success of defensive naval campaigns that we shall be able to use for our fighting ships those harbors which nature has provided. Although possessing bases for fleets in that region, the fact that there is not enough depth of water for our fighting ships to enter them will render them of but slight benefit to us.

"It is submitted further that the artificial deepening of channels and entrance is not a good solution of this difficulty, because such dredged channels are of necessity narrow, easily blocked, and very sensitive to injuries from an enemy or the elements.

"The effort to remedy a shoal entrance by dredging a narrow channel across the bar seems unwise as far as naval and military questions are concerned, and the true remedy, in the opinion of the War College, lies in decreasing the draft of the warships to a point permitting them to enter.

"The college, therefore, respectfully suggests that future ships of war be planned for an extreme deep-load draft, with maximum coal supply on board of 23 feet, and submits that considerations of strategy upon our Atlantic and Gulf coasts render this an essential to successful naval campaigns.

The policy of the naval authorities for the present is to confine construction to battle-ships and torpedo-boats.

The Secretary asks Congress to authorize the building of a dock at Norfolk large enough to take in the largest vessels in the navy. This, he urges, should be built of concrete. He also believes that a navy yard should be established at some Gulf port.

The supply of ammunition for the navy is at present limited to a complete outfit for each vessel. The last Congress appropriated $250,000 for spare projectiles, but the Secretary is so impressed with the need of immediately providing at least double the present stock of powder and projectiles on hand that he urges an appropriation for this amount and that the purchase be made at once, in this country if possible, but abroad if our own manufacturers cannot supply it quick enough.

All ships designed to carry torpedoes are now supplied with them and there is a good supply of torpedoes on hand.

The progress in gun construction is given as follows:

"During the past four years 213 guns have been manufactured of all calibers, as follows: Seventy 4-inch, 71 5-inch, 6 6-inch, 45 8-inch, 1 10 inch, 8 12-inch, 12 13-inch. Including the 20 sets of 4-inch, 35 sets of 5-inch, 50 sets of 6-inch and 2 sets of 8-inch gun forgings, for which contracts have been awarded, we have in course of manufacture at this date 196 guns of all calibers from 4-inch to 13-inch. Of these, 63 guns are for the auxiliary naval cruisers, for which an appropriation was made at the last session of Congress. In addition to the above 100 3-inch field guns, for landing and boat service, are in hand and will be completed in the near future. March 1, 1893, 116 guns of all calibers were mounted aboard ship. At present, including some temporarily landed pending repairs of vessels, there are 366."

"Our projectiles of all calibres are manufactured by private firms of which there are at least seven possessing the necessary plant and skill for the manufacture of the various kinds required. Armor-piercing shells are now being supplied to the navy, capable of withstanding the test of passing through a caliber of hard-faced armor quite as well as those of earlier manufacture did that of passing through a calber of simple steel. A new type of shell, called semi-armor-piercing, has also been developed to meet the modern practice of armoring large portions of heavy ships with armor from 4 to 6 inches thick. These shells will carry large bursting charges through half a caliber of armor and explode after having gone through."

The present strength of our navy is 42 vessels of 137,850 tons' displacement. The experiments made with liquid fuel by Engineer-in-Chief Melville have led to its trial in a tug, now being built at Norfolk, and a torpedo-boat under construction at Herreshoff's.

For the relief of the engineer corps it is urged that the limit to their number be increased from the present number of 194 to 250.

Electricity on the New York, New Haven & Hartford Railroad.

Recent dispatches in the daily press state that while the leading officials of the New Haven road will not give the details of the reported three-rail electrical branch between New Britain and Hartford, via Berlin, they admit that the power station is practically assured, and that similar power-houses will be constructed in a short time on various branches of the main lines in this State. President Charles F. Clark, of the road, was interviewed and said:

"I am not yet prepared to say that work will immediately be begun on the erection of the power station at Berlin, but its erection has been under consideration for some time. An announcement that work will be immediately undertaken may or may not be made within a short time.

"The general policy of the New Haven road relative to the introduction of electricity as a motive power may be given as follows: Electricity as a motive power is foreshadowed in the last annual statement of the road. On the south shore branch of the Old Colony system, the current has been successfully and economically conveyed in a third rail, insulated upon wooden blocks in the center of each track. The results have surprised experts, and it is now probable that a third rail will be laid at various points upon the company's property during the year to come. Short branches to the centers of business and population may then be constructed from the company's lines."

The "Engineer" Horseless Road Carriage Competition.

Our contemporary *The Engineer* (London) has arranged a road carriage competition to take place during the month of May, 1897. It will award 1,100 guineas in prizes as follows:

A.—For the best mechanically propelled vehicle constructed to carry—including the driver—four or more persons, the total weight, when fully loaded, not exceeding two tons, a prize of 350 guineas will be given.

B.—For the best mechanically propelled vehicle constructed to carry either one or two or three persons, the total weight, when fully loaded, not exceeding one ton, a prize of 250 guineas will be given.

C.—For the best mechanically propelled vehicle constructed to carry, in addition to the driver, not more than one ton of goods, or parcels, the total weight, when fully loaded, not exceeding two tons, a prize of 250 guineas will be given.

D.—For the best mechanically propelled vehicle constructed to carry, in addition to the driver, five hundredweight of goods or parcels, the weight, when fully loaded, not exceeding one ton, a prize of 150 guineas will be given.

Supplemental.—For the vehicle, whether for passengers or goods, propelled solely by a motor actuated by the vapor of oil or spirit, having a lower specific gravity than 0.8, or a flashing point lower than 73 degrees Fahrenheit, Abel's test, and constructed to satisfy the requirements of any act of Parliament, and the rules to be made thereunder for the time being respectively in force, which, in the opinion of the judges, best satisfies the purpose for which it is built, a prize of 100 guineas will be given.

The carriages must be delivered at the Crystal Palace, Sydenham, England, during the week prior to May 24, 1897, and entries must be made before April 1. Inspections and trial runs will be made at the Palace and the road race will take place about May 31 over a route to be named three days before the race. The distance will be at least 200 miles. The judges in making the awards will take into consideration the following: *a*, distance run without taking on supplies, freedom from stoppages; *b*, design and workmanship of machinery and carriage; *c*, safety; *d*, simplicity, durability, accessibility and facilities for repairs, absence of offensive smells, and of excessive vibration; *e*, time occupied in getting to work and ease of starting; *f*, speed up to ten miles per hour and hill climbing; *g*, control, certainty of steering gear and efficiency of brake gear; *h*, weight; *i*, first cost and cost of operation; *j*, general efficiency.

Full particulars can be obtained from the publishers of *The Engineer*.

Piece-Work in Repair Shops.

The claims in favor of piece work set forth in our article on the Altoona Shops, last month, find corroboration in an article on the same subject by Mr. C. F. Webelacker, in the *Street Railway Journal*. His experience is in street car work, but the story is much the same. His opening paragraph is suggestive to those who have to contend with small shops and overtaxed facilities. He says:

"Some time ago the writer was brought face to face with the fact that the shop facilities with which he was attempting to handle the maintenance of equipment for his company were entirely inadequate. The amount of equipment and the mileage was continually on the increase and there was no prospect of an immediate increase in the size of the shop. The problem before him was to make the necessary repairs on upward of 600 cars in a shop where the pit room would accommodate 16 cars at a time, and in addition to making the regular running repairs, to carry on a very considerable equipment business. The first step, of course, was to improve the facilities for handling the various parts with an eye to expediting the work. This effort was, however, very poorly seconded by the workmen. They seemed to consider each innovation as simply a scheme to lay off men and consequently were very loath to find any virtue in improved machinery."

As experience had shown that the amount of work turned out could not economically be increased by adding to the shop force, piece-work was resorted to. The extent to which the capacity of the shop was increased, even with a reduced number of men, can be realized from the fact that where 66 men working seven days a week and more or less overtime had, under day-work, averaged $11\frac{4}{10}$ cars repaired per day, 45 men on piece-work, working $5\frac{1}{2}$ days per week, turn out on the average $12\frac{4}{10}$ cars repaired per day. The average cost per car has been reduced from $19.25 for labor to $15.14.

The price list was carefully worked out before the piece-work was inaugurated, and proved to be in the main correct. A complete system of supervision and recording was necessary, but it presented no unusual difficulties. The wages of the men averaged 10 per cent. higher with piece-work. At first some of the men were careless, but as they had to make good all their bad work without additional compensation, the carelessness soon disappeared. In fact, after the system was fairly under way the cars averaged a higher mileage between repairs than under the old system. The author concludes that "opposed to these advantages are the increased difficulty and labor in keeping time, and the increased inspection necessary; that these disadvantages are more than offset by the advantages, the figures above quoted plainly show."

The Electric Motors on the Brooklyn Bridge.

During the last month the new motor cars were put in regular service on the Brooklyn Bridge. Like most new installations they have had their series of mishaps, more illustrative of what is occasionally spoken of as the natural cussedness of things inanimate than of any defects of the apparatus. The first troubles arose from several derailments of the motor cars on the sharp curves at the terminals, due, it is claimed, to the newness and stiffness of the trucks. The delays culminated a few days ago in the breaking of a crosshead of a 2,000 horse-power engine in the street railway powerhouse from which the bridge cars were temporarily taking their current. But, notwithstanding these troubles the new motors have demonstrated their value.

The electric motors are used to perform the switching operations at the terminals of the bridge, while the cables haul the trains over the bridge as formerly. The motor cars are not any different in general appearance from the other cars, and there is one of these cars in each train. They take current from a third rail, and after the train has unloaded its passengers on the in-coming platform, the motors switch it over to the outgoing platform. After the passengers are taken on the motors start the train out of the terminal until the grips take the cables, after which the motors are idle until the other end of the bridge is reached. The motors being always coupled to their trains much time is saved in the switching operations over what was possible with the steam locomotives. When the cables are stopped, shortly after midnight, the motor cars are operated all the way over the bridge.

Each motor car is 45 feet long over all and weighs complete about 30 tons. The trucks are made by the McGuire Manufacturing Company, of Chicago, and each truck has two G. E. 50 motors. Each car has two K. 14 series parallel controllers. The third rail from which the current is taken is located about one foot from the outside rail, and is supported on insulators of vitrified clay placed on every fifth tie. It is an ordinary T-rail bonded with No. 0000 bonds. The return is through the track rails which are bonded with No. 0 bonds. The contact shoes are supported from an oak beam between the wheels on each side.

The contract for the electrical equipment called for power enough to take a fully loaded train weighing 120 tons across the bridge at a speed of 11.3 miles per hour (the speed of the cable). The grade is 3.78 per cent. at the maximum, and the motors have demonstrated their ability to do this work. When the double tracks and cables are put into operation it is expected that the headway of the cars will be reduced to 45 seconds instead of 90 as it present. Then there will be two incoming and two outgoing platforms at each terminal.

One of the New York *Sun's* European correspondents says that a German court made an odd ruling last month in a remarkable case of larceny. A man was accused of stealing several thousand amperes of electricity by tapping a light company's wires and using it to run a dynamo. The Court, on appeal, ruled that only a movable material object could be stolen, which electricity was not, and therefore the man was acquitted.

American Society of Mechanical Engineers.

The annual meeting of the American Society of Mechanical Engineers was held at the house of the society, 12 West Thirty-first street, New York, Dec. 1 to 4. The attendance was unusually large, the total enrollment on the register being 556.

The first session was held on the evening of Dec. 1 (Tuesday), at which time the President, John Fritz, read the annual address. the subject being "The Progress in the Manufacture of Iron and Steel in America and the Relations of the Engineer to it." An abstract of this address is published elsewhere in this issue.

WEDNESDAY MORNING.

The first business session of the meeting was held on Wednesday morning. The report of the council gave the total membership as 1,762, as follows: Honorary members, 16; members, 1,342; associate members, 104; junior members, 300. There are also 65 life members.

The council reported that its efforts to secure proper recognition for the naval engineers of the United States had resulted in a memorial to Congress addressed to the Committee on Naval Affairs of each House, and a circular sent to members of the society asking their individual co-operation.

The council has appointed a committee, consisting of Messrs. Coleman Sellers, Prof. John E. Sweet, Charles T. Porter, George M. Bond and Coleman Sellers, Jr., to prepare material to be used in opposing legislation looking to the compulsory adoption of the metric weights and measures.

The reports of the Finance Committee and Library Association were gratifying. The total receipts for the year were $28,869. The report of the tellers of election showed this result: President, Worcester R. Warner, Cleveland, O.; Vice-President, E. S. Cramp, Philadelphia; S. T. Wellman, Cleveland; W. F. Durfee, New York; Treasurer, Wm. H. Wiley, New York; Managers, H. S. Haines, Atlanta, Ga.; Gus C. Henning, New York; A. W. Robinson, South Milwaukee, Wis.

The committee on tests of fire-proof materials, methods of testing and standard methods of boiler testing reported progress. A communication from the Secretary of the American Steel Manufacturers' Association stated that the decimal gauge had been adopted by the association.

The first paper was that of Sir Henry Bessemer entitled:

AN HISTORICAL AND TECHNICAL SKETCH OF THE ORIGIN OF THE BESSEMER PROCESS.

The great impetus given to the manufacture of steel by the introduction of this process and the vast developments that have resulted from it naturally make this sketch by the inventor of the process one of great interest. The paper illustrates some of the apparatus used in the early experiments, beginning with the reverberatory furnace for improving cast iron by fusing in the bath broken-up bars of blister steel. This was in 1855. In the alterations of this furnace, from time to time, an arrangement of admitting air at the bridge was tried to complete the combustion of the gases, and it was noticed that the bath was partially decarburized. Later on some pieces of pig which had remained unmelted in spite of the great heat of the furnace remained unfused when a greater quantity of air was admitted, but when broken up were found to be thin shells of decarburized iron, having been reduced to this state by air alone. This gave a new turn to the experimental work which finally resulted in seven hundred weight of iron being decarburized without the use of fuel. The description of this first blast is interesting:

"All being thus arranged, and a blast of ten or fifteen pounds' pressure turned on, about seven hundredweight of molten pig iron was run into the hopper provided on one side of the converter for that purpose. All went on quietly for about ten minutes. Sparks, such as are commonly seen when tapping a cupola, accompanied by hot gases, ascended through the opening in the top of the converter, just as I supposed would be the case, but soon after a rapid change took place. In fact, the silicon had been quietly consumed, and the oxygen next uniting with the carbon, sent up an ever-increasing stream of sparks and a voluminous white flame; then followed a succession of mild explosions, throwing molten slags and splashes of metal high up into the air, the apparatus becoming a miniature volcano in a state of active eruption. No one could approach the converter to turn off the blast, and some low, flat zinc-covered roofs close at hand were in danger of being set on fire by the shower of redhot matter falling on them. All this was a veritable revelation to me, as I had in no way anticipated such violent results. However, in ten minutes more the eruption had ceased, the flame died down, the process was complete, and on tapping the converter into a shallow pan or ladle, and forming it into an ingot, it was to be wholly decarburized malleable iron."

From this point the account deals chiefly with the perfecting of the process, and references are made to other inventors and their work. The author is a little severe on the work of Kelly and Mushet and in the discussion of the paper several members well versed in the early history of steel-making took exceptions to the way in which other inventors were treated in the paper. Mr. W. F. Durfee was a participant in the work of Kelly and ably defended that inventor. Messrs. Allen Stirling, R. W. Hunt and Wm. Kent contributed written discussions. The highest respect for Sir Henry Bessemer was expressed, but the facts about the work of others were clearly stated.

ANCIENT POMPEIIAN BOILERS.

This paper by Mr. W. T. Bonner, of Cincinnati, is descriptive of a number of boilers used by the ancients in heating water for domestic purposes. They were found in the ruins of Pompeii and are now in the National Museum in Naples. The most remarkable boiler is one in the form of a vertical cylinder 30 centimeters (about 12 inches) internal diameter and 42 centimeters (about 16½ inches) high. It has a water-tube grate, and a round firebox with a semi-spherical crown. This and the other interesting boilers described show, in the author's word, that "the water-tube principle, the crowning feature of the most successful boilers of to-day, was fully understood and appreciated by the Greeks and Romans two thousand years ago."

The discussion brought out information concerning a boiler that is even nearer to present practice; for Mr. Durfee stated that in the same museum there was a boiler whose firebox and tubes were arranged exactly like the common vertical boiler of the present day.

THE MOMENT OF RESISTANCE.

This paper was presented by Mr. C. V. Kerr, of Chicago, and opens with an argument in favor of the use of the term moment of resistance in computing the strength of beams instead of the moment of inertia. The author says that "A way out of the difficulty could be found in associating the resisting moment, as proposed by some and used by others, with the established bending moment, and in tabulating, for the use of engineers and architects, the values of R, as found directly by analytical or graphical methods from a given section of beam, in terms of stress and dimensions, or numerically when either the safe working stress in extreme fiber or unit stress at unit distance from the neutral axis is assumed and stated."

The paper also contains formulas for the moment of resistance of the regular geometrical sections and an analytical method for use on irregular sections.

METHOD OF DETERMINING THE WORK DONE DAILY BY A REFRIGERATING PLANT AND ITS COST.

The author, Mr. Francis H. Boyer, discusses the methods employed at the refrigerating plant at the abattoir of John P. Squire & Company, East Cambridge, Mass., installed by the De La Vergne Refrigerating Machine Company during the winter and spring of 1890 and 1891. It is composed of two machines rated by the builders as 150-tons ice-melting capacity each daily, or a combined capacity of 300 tons, this to be accomplished by running 24 hours daily with a return pressure of 26 pounds above atmosphere, or 40$\frac{7}{10}$ pounds pressure absolute, running at 40 revolutions per minute. The size of the gas-compressing cylinders were 16 inches in diameter and 32 inches stroke, and, being double-acting, there were four gas cylinders all told.

The condition and amount of work being done is indicated by the back or return pressure of the gas—this condition being maintained by the speed of the gas pump—the engines being directly connected and constructed to allow of a variation of speed from 15 to 75 more revolutions per minute.

It became desirable to establish a method to obtain the amount of work accomplished daily in order to arrive at the expense of operation, and to make comparison with results of other departments of the abattoir. By taking the cubic displacement of the compressors with a given amount of return pressure the amount was obtained easily.

A copy of the engineer's logs for July 18, 1896, is given and explained.

The object of the paper is to ascertain the amount of work done under the varying conditions of service and reducing this to the standard set of conditions. The average number of revolutions is 40: 26 pounds per square inch is the return pressure for a given result and 150 tons is the rated capacity of the machines, when the fixed conditions are maintained. The actual hours, revolutions and return pressure can be inserted as numerators in the following equation :

$$\frac{\text{Hours.}}{24} \times \frac{\text{Revolutions.}}{40} + \frac{\text{Return pressure.}}{26} \times \frac{\text{Tons refrigerating.}}{150}$$

In determining the cost of operating several tests had been made on the boiler and engine plant, which showed an average of $10\frac{47}{100}$ pounds of water vaporized per pound of coal consumed, Pocahontas coal from Virginia being used, and with an efficiency of $16\frac{44}{100}$ pounds of steam per hour per horse-power, or $1\frac{56}{100}$ pounds of coal per hour per horse-power.

The total expense for operating is taken monthly from the store-room accounts ; from the year 1894 we have the following :

Tons of refrigerating produced	48,466⅙
Cost of maintaining refrigerating department, including annual repairs	$28,471 63
Average cost per ton for refrigeration for 1894, cents.	$58\frac{7}{10}$

The monthly statement for that year shows that the cost per ton varied from a maximum of 86 cents to a minimum of 24 cents, the fluctuation depending upon the quantity required.

THE PROMISE AND POTENCY OF HIGH-PRESSURE STEAM.

This is an elaborate paper by Prof. R. H. Thurston, in which he reviews the economy obtained for increasing steam pressures up to the present time, and gives his views of the probable result of a still further increase. He comes to the conclusion that the final limitation to increased steam pressures will be a financial one rather than a mechanical or thermal one—that is to say, that ultimately the increase in the cost of boilers and engines will offset the gain in economy of operation. In his paper he gave an account of a boiler and engine built at Cornell University for steam at 500 pounds' pressure.

This was the closing paper of the session.

Wednesday Afternoon and Evening.

The afternoon session was a memorial meeting, in memory of the late Mr. J. F. Holloway. Secretary Hutton had prepared a brief sketch of Mr. Holloway's life, and he was followed by others, who testified to the respect and esteem in which Mr. Holloway was held by all who knew him. His genial and kind-hearted manner to all with whom he was associated, his genuine interest in the welfare of others and his charming personality will long keep his memory bright in the minds of his many friends.

In the evening there was reception at Sherry's, which proved to be an enjoyable occasion and was well attended.

Thursday Morning.

EXPERIMENTAL INVESTIGATION ON THE CUTTING OF BEVEL GEARS WITH ROTARY CUTTERS.

This paper was contributed by Messrs. F. R. Jones and A. L. Goddard, of Madison, Wis., and gives the results of experiments made to determine the angles at which the gear cutter should be set for the final operations on a bevel gear cut in a universal milling machine. These final operations consist of cuts first on one side and then on the other side of the teeth, and the setting of the machine is generally done by a "cut and try" method. The authors, as the result of their experiments, constructed a diagram from which the settings can be accurately determined.

CALIBRATION OF A WORTHINGTON WATER METER.

In this paper Mr. J. A. Laird of St. Louis gives the results of a series of meter calibrations extending over more time than any heretofore presented to the society. The meter tested was a Worthington made entirely of brass, for hot water, and bought for testing purposes. It was used to measure the feed water during the two 30-day duty tests on the Allis engines at the Chain of Rocks pumping station, St. Louis.

The tests show that the maximum error was 2½ per cent., but this was unusual, and the author is of the opinion that the records of his work show that with careful calibration results can be obtained with a Worthington meter that will not be in error by more than ½ of 1 per cent.

CONTRACTION AND DEFORMATION OF IRON CASTINGS IN COOLING FROM THE FLUID TO THE SOLID STATE

is the title of a paper by Mr. Francis Schumann, of Philadelphia, in which the relations between the form of castings and their contraction and deformation in cooling is dealt with. The author first gives the general laws and discusses the contraction of prisms. Among the constituents of iron, carbon has the greatest influence upon the rate of contraction when in a combined state, while an increase in free carbon has the opposite effect. Increasing the silicon up to 10 per cent. causes the iron to become brittle and weak and increases contraction. Sulphur tends to change the carbon into a combined state and hence increases contraction. Phosphorus has little effect upon the carbon, but it lessens the rate of contraction and diminishes the strength of the iron. Manganese up to 1 per cent. has little effect, but when it reaches 1½ per cent., and the iron is low in silicon, it tends to hardness and increased contraction. Repeated remelting increases the rate of contraction. Formulas are given based on the results of actual measurement of castings of various sizes from small sections up to some of nearly 600 square inches. The conclusions of the author are that the deformation of prisms due to unequal contraction can be overcome by providing counter-deformation in the pattern or by the addition of parts that can easily be removed from the casting; that in complex machinery castings the design should be so modified or chosen that these will result in the least differences in cooling, sudden changes in form resulting in severe stresses, which should be avoided; that imperfetly proportioned flanges, ribs or gussets added to the main body of a casting, for either the purpose of increasing the strength or connections, may be sources of weakness; and, finally, that greater attention to the laws of cooling and correct forms and proportions of castings will result in increased strength and economy, besides the avoidance of annoying crooked castings and mysterious breakdowns.

In the discussion which followed, Mr. Henning described Mr. Keep's method of making his test bars. He also showed that the work of Mr. Schumann was in line with the work of the Committee on Testing. Mr. John Brashear spoke of his difficulties in casting glass for lenses, and talked interestingly of the manner in which cooling strains revealed themselves in the glass castings by means of the polariscope. He believes that if a special furnace was constructed for the heating and slow cooling of test pieces of cast iron much valuable information would be obtained. President Fritz and several other members also took part in the discussion.

A TWO HUNDRED-FOOT GANTRY CRANE.

This paper we will publish in abstract next month.

THE WASHING OF BITUMINOUS COAL BY THE LUHRIG PROCESS.

This paper we will also publish in abstract next month.

FRICTION HORSE-POWER IN FACTORIES.

In this paper the author, Mr. C. H. Benjamin, of Cleveland, gives the results of a series of experiments made under his direction by Messrs. McAllister and Morley, of the Case School of Applied Science. The investigation included 16 different establishments, among which were stamping mills, bridge works, machine shops, etc., etc. Cards were taken from the engine during the day when under load, and at noon cards were taken with the engine running light. The shafting was all inspected and its

length and diameters, number and length of belts and other data collected. The paper contains the results in tabulated form. The percentage of the total power required to drive the shafting in the group of shops that could be classed under heavy machine work was 62.3, and in the group of light machine work it was 55.1 per cent. The author says that in ordinary machine shops the following rules if carried out would effect a saving of fuel by reducing the friction:

1. Use pulleys of large diameter on counters and narrow fast-running belts.

2. Use nothing but the best oil, and plenty of it, catching all drip, and either purifying it or using it for some other purpose.

3. Have all the shafting and counters oiled regularly, and do not depend too much on automatic oiling.

4. Inspect line shafts from time to time, and see that they are in line and can be turned easily.

Thursday Evening.

SOME SPECIAL FORMS OF COMPUTERS.

This is a description by Mr. F. A. Halsey of computers provided with logarithmic scales similar to a slide rule, but each is designed for the solution of a special set of problems and the scales are sufficiently numerous to take care of all the factors, so that one setting will enable the operator to read off the result, instead of solving the problem by several steps, as would be required with the common slide rule. Moreover, the scales are long enough to cover all probable values of the quantities, so that there is no trouble in locating the decimal point. A gear computer is illustrated as an example and it contains six scales, one for each of the factors, pitch of tooth, face of tooth, revolutions per minute, diameter of gear, pressure co-efficient, and horse-power. The advantage of these Cox computers, as they are called, is very great where problems of a similer character must be solved frequently in the course of business.

RUSTLESS COATINGS FOR IRON AND STEEL.

This is the fourth paper on this subject presented to the society by Mr. M. P. Wood, and deals chiefly with the case of corrosion in the British steamer *Glencairn*, a steel vessel which, while loaded with "burnt ore," struck a rock and sunk on the beach in Scallaster Bay. Though raised in six days the corrosion was so great that all the cast-iron surfaces of her machinery were softened to the depth of $\frac{3}{32}$ of an inch to such an extent that they could be cut with a knife. Even the cylinders had to be rebored to remove this soft material. All steel work was also deeply pitted where bare, but wherever surfaces were painted they were untouched. The cause of the corrosion was the sulphate of copper in the burnt ore. Before going into the details of this remarkable case, the author points out the importance of the general subject in view of the skyscrapers now being erected in large cities and the great bridges projected over the East and North rivers at New York. He evidently believes the present methods of protection of steel in these large structures are unsatisfactory. Next to a good paint, the method of applying it is of importance, and he states that a poor paint properly applied will give better results than a good paint improperly applied to a surface not properly prepared for it. He condemns linseed oil free of pigment, and also oxide of iron in any form.

In the discussion one or two cases were cited showing the good effect of painting, but much of the discussion turned upon the joints for wires used in bridge cables, a point which the author had touched upon in his paper.

A METHOD OF DETERMINING SELLING PRICE.

The purpose of this paper, by Mr. H. M. Lane, of Cincinnati, is to propose a method by which the conditions affecting the final result of a year's business may be shown in a simple manner at the end of each week or month. It is not a substitute for book-keeping, but an auxiliary for the convenience of the manager relating to organization and operation. The method is to prepare an annual estimate of the business in which all the items of expenditure and receipts are enumerated and the getting out blanks for weekly or monthly use on which each of these items appears. The blanks if in monthly form have one column for each month and in that column two spaces for each item. The upper of these spaces is immediately filled by the estimated item divided among the 12 months. The other space is for the actual figures resulting from the business. Thus at any time the state of the business can be known and accurate and intelligent supervision is made possible of each expenditure in its relation to the year's business.

TESTS OF FIRE-PROOFING MATERIALS.

The tests recorded in this report have already been published in our columns (see September number page 228).

Friday Morning.

THE EFFICIENCY OF THE BOILER GRATE.

The final session opened with the reading of a paper with the above title, by Mr. W. W. Christie, of Paterson, N. J. The paper contains data from 108 carefully made boiler tests. The rates of combustion vary from from 4.7 to 57 pounds per square foot of grate and the author finds that the most economical rate of combustion for hard coal to be 13 pounds and for soft coal 23.8 pounds per square foot per hour.

The author also gives some figures on chimneys.

In the discussion Mr. William Kent condemned the paper as wrong in many particulars. He said there were errors in the data that were obvious, that even the average line of the diagram was wrong, and that if the doubtful tests were eliminated, the results would not support the author's conclusions.

EFFICIENCY OF BOILER HEATING SURFACE.

In this paper, Mr. R. S. Hale, of Boston, discusses the formulas of Rankine, Clarke, Isherwood, Carpenter and Emery for boiler efficiency and in doing so goes more deeply into mathematics than would seem advisable under the circumstances. Those who know anything about boiler heating surfaces know that our knowledge of their efficiency is not in such an advanced state as to warrant going through extensive mathemetical gymnastics with the data at hand.

In the discussion Mr. Geo. I. Rockwood spoke of the use of economizers and said that in England the cost much less per square foot of heating surface than did the boiler, while in this country the reverse was the case. This explained their more general use in that country.

PAPER FRICTION WHEELS.

This paper is by Prof. W. F. M. Goss, of Purdue University, and, like all his contributions to technical literature, is of great practical value. He has made an experimented study of the power which paper friction wheels will transmit, employing for the purpose 5½-inch, 8-inch, 12-inch and 16-inch paper wheels, all in contact with a 16-inch cast-iron wheel. The contact pressure varied from 75 pounds per inch width of contact to over 400 pounds, and the peripheral speed from 450 to 2,700 feet per minute. The results show that slippage of more than 3 per cent. is likely to lead to a stoppage of the driven wheel. The co-efficient of friction is apparently constant for all pressures up to a limit which lies between 150 and 200 pounds per inch width of contact. At 400 pounds its value is from 10 to 15 per cent. less than at 150 pounds. Friction wheels from 8-inch in diameter up give about the same co-efficient, but for 6-inch wheels it is lower by about 10 per cent., which would indicate that it would fall still more as the diameter is reduced. Variations in speed within the limits named do not affect the coefficient. The horse power that can safely be transmitted by wheels 8 inches or more in diameter is given as:

$$\text{H. P.} = \frac{150 \times 0{\cdot}2 \times \frac{1}{2}\pi d \times W \times N}{33{,}000} = .000238\ d\ W\ N$$

in which d is the diameter of the friction wheel in inches, W the width of its face in inches, N the number of revolutions per minute, 0.2 the safe coefficient of friction, and 150 the pressure of contact.

STEAM ENGINE GOVERNORS.

In this paper Mr. Frank H. Ball, of Plainfield, N. J., investigates the accelerating forces in governors from a practical standpoint. The three forces to be taken account of in modern governors he defines as centrifugal force, tangential accelerating force and angular accelerating force. These forces he discusses at some

length in a most clear and instructive manner. The necessity of including in the governor problem all the forces developed by the pivotal swing of the governing mass he illustrates in a very apt manner, by calling attention to the fact that while the centrifugal force may vary directly as the radius, the rule does not hold good during a period in which a change of radius takes place. This will be comprehended when it is borne in mind that during a sudden increase in radius the mass may take a path corresponding to a tangent, during which time the centrifugal force would be zero. Another and a very important modification of force that appears during the period of radial motion is that due to the great change in lineal velocity that necessarily follows a change in the radius of rotation, either with or without a change in the rate of rotation, and which develops an accelerating force acting on a tangent to the axis of rotation.

After completing his discussion of the forces and the effect upon them of different locations of pivotal points, the author arrives at the following conclusions: First, Centrifugal force is the most important governing force, because it is indispensable; second, Angular accelerating force is next in importance, because it is an unqualified help as an actuating force, and its practical usefulness is limited only by constructional considerations; third, Tangential accelerating force is of questionable utility, because of the disturbing forces that it is almost sure to put in operation.

Perhaps we had better explain the meaning of the term "angular accelerating force" used by the author. If a governor weight is in the form of a mass concentrated at its center of gravity, this force cannot exist, but if as an illustration we assume the weight to be in the form of a bar of some length, it is evident that for each complete rotation of the governing wheel the weight has passed through 360 degrees of rotation around its own center of gravity, and the longer the bar or the further its mass is disposed from its center of gravity, the greater is the force developed by the "angular accelerating force" under a given set of conditions.

THE METRIC VERSUS THE DUODECIMAL SYSTEM.

This is a very valuable paper by Mr. George W. Colles, in which he reviews the facts in regard to the past history and present status of our own system of weights and measures and the metric system. His own opinions do not favor the metric system. His paper is very long—98 pages—and we confess that we have not gone over it carefully enough to notice it at this time; we may take it up again.

ALUMINUM BRONZE SEAMLESS TUBING.

This paper, presented by Mr. Leonard Waldo, describes this material and the author exhibited samples of it. He states that the bronze appears to be not a mere alloy, but a chemical combination.

The above paper concluded the programme for the meeting, but before it adjourned, Mr. F. H. Stillman presented the society with the first hydraulic jack ever made. It is one of Mr. R. Dudgeon's jacks and is in good condition. After this presentation the meeting adjourned.

Railways and Car Building in Japan.

In Japan, there are now 2,188 miles of railways working, 1,882 miles under construction and 1,342 miles of proposed lines. The gage is 3 feet 6 inches, and the rails are 60 pounds per yard. At present the question of widening the gage to 4 feet 8½ inches is being considered. The rolling stock is mostly of English make, but there are some American and German locomotives. Lately locomotives were built in the workshop of the Imperial Government Railways in Kobe, under the superintendence of Mr. R. F. Trevithick, who is the grandson of the great Trevithick, the famous locomotive builder.

Passenger cars and freight wagons are now built in the workshops of the Imperial Government Railways and several private railway companies. The Niphon Tetsudo Kwaisha, which is the largest railway company in Japan, is now building a large workshop in Omiya (16¼ miles from Tokyo) for the purpose of constructing locomotives, cars and wagons by the company's own hands. This railway company has sent locomotive and civil engineers to America and Europe to study railways in those countries. The Hiraoka Car Works, which were formerly in the compound of the military workshop in Koishikawa, Tokyo, have removed to the new workshop at Honjow in the same city, where cars and wagons are intended to be built extensively. From this firm also Mr. Hiraoka, Jr., who is the younger brother of the proprietor of the workshop, was sent to America in order to study car-building there.

Besides these, several famous capitalists in Japan are now planning to form a company for manufacturing railway rolling stock, of which the capital is said to be $500,000. The company is proposing to establish two workshops, one in Tokyo and the other in Osaka. As the labor in Japan is very cheap compared with America and Europe, the establishment of such a company will diminish the imports of railway rolling stock from other countries. Iron works are also going to be established by the Japanese government for the purpose of manufacturing this important engineering material on a large scale. But it will be some years before rails are made in Japan. The success of these schemes will check in no small degree the overflow of Japanese capital to the Western lands.

Thornycroft Water-Tube Boilers for the New Torpedo Boats.

Several of the torpedo boats and destroyers recently ordered by the United States Government will be supplied with Thornycroft water-tube boilers. The 30-knot destroyer for which the Union Iron Works has the contract is to have three of these boilers, aggregating 5,600 horse power. These will form an interesting installation, as each boiler will be of practically 2,000 horse power. The two 22½-knot boats to be built by Wolff & Zwicker will also have Thornycroft boilers; each boat will have two boilers aggregating 1,850 horse-power. The 20-knot boat building at the yard of Charles Hillman, in Philadelphia, will have two Thornycroft boilers aggregating 900 horse-power.

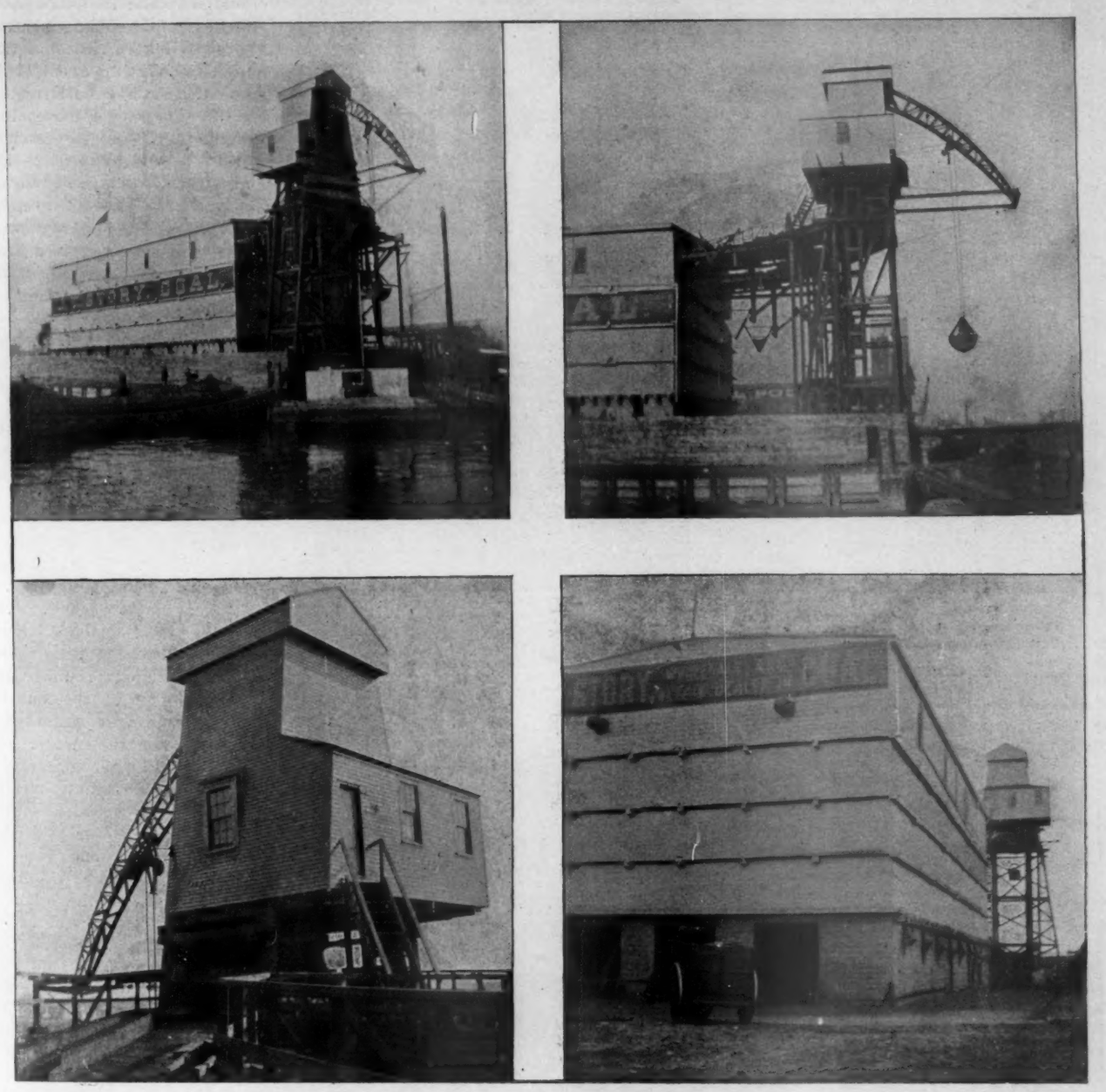
The manufacture of Thornycroft boilers in this country is controlled by Messrs. Thorpe, Platt, & Co., 97 Cedar street, New York. They are meeting with gratifying success in the introduction of the boilers here. The boilers have purposely been confined entirely to marine uses. In the offices of Thorpe, Platt & Co. there is a duplicate of the model boiler to which Mr. Thornycroft referred in one of his recent admirable papers on circulation in water-tube boilers. It is constructed with glass plates in the ends of the steam drum through which the workings of the boiler can be watched. It is fired with gas and can be started at a moment's notice. Those interested in water-tube boilers will find it instructive to watch this model at work, and it can be seen by them at any time at the office of these gentlemen.

Canadian Society of Civil Engineers.

The annual meeting for the election of the Council for 1897, and the transaction of other business, will be held in the Society's rooms, 112 Mansfield street, Montreal, on Tuesday, January 12, at 10 a. m. By the kindness of the Grand Trunk, Canadian Pacific and Intercolonial Railways, members and their families who shall have paid full one-way first-class fare going to the meeting, will be returned free, on presentation of a certificate signed by the ticket agent [from whom the certificate must be obtained] at the point of starting, and by the secretary of the Society.

Western Railroad Association.

On the 14th of November the offices of the Western Railroad Association in Chicago were removed to the Marquette Building, corner of Dearborn and Adams streets, Rooms 1327 to 1333, inclusive. All communications should be addressed to the Western R. R. Association; Room 1330, Marquette Building, Chicago, Ill.



Coal-Handling Plant for J. T. Story, Brooklyn, N. Y.—Fig. 1.
Built by the C. W. Hunt Company, New York.

Coal Handling Machinery at the Yard of J. T. Story Brooklyn, N. Y.—Built by the C. W. Hunt Company.

The cost of handling coal entirely by machinery is recognized to be so much less than by any of the old methods in which manual labor is employed wholly or in part, that the use of such machinery is rapidly increasing. One of the latest examples of a moderate size plant of this kind is the one recently completed for Mr. J. T. Story, of Brooklyn, by the C. W. Hunt Company, of New York. Mr. Story is a large dealer in coal in the city of Brooklyn, where he operates six large yards. The last addition to his facilities is located near the junction of Morgan and Johnson avenues and is on the bank of a canal branching from a creek opening into the East River. The coal is received in barges and both anthracite and bituminous coal are handled at this yard. The building in which it is stored is 135 feet long, 62 feet wide, and 50 feet high to the top of the bins. It contains 18 bins or pockets, each capable of holding 300 tons of coal without trimming or 350 tons if trimmers spread the coal after it is dumped from the cars. The total storage capacity is thus from 5,400 to 6,300 tons.

In Fig. 1 we have grouped four views of the plant, the first of which shows it as seen from the water side; the second is a side view of the hoisting tower, the third is a rear view of the top of the tower in which the hoisting engine is placed, and the fourth is the rear of the storage building. The method of handling the coal is to hoist it from the barges to the top of the tower by means of a two-ton steam shovel, where it is dumped into a hopper; from the latter it is discharged into the automatic cars which run on tracks on the platform extending from the tower to the building. The tracks are on a slight down grade, and the cars run into the building of their own weight, where they automatically dump their contents into the bins and return automatically to the hopper in the tower. From the bins the coal is drawn off into wagons through chutes at the bottom, that screens the coal as it is delivered to consumers. Thus at no point is the coal handled directly by men, and in getting it into the bins the number of men required is reduced to a minimum. The engineer in the tower controls all movements of the bucket, and two men are in charge of the cars carrying the coal to the bins. The boiler room is down on the ground, and of course requires the

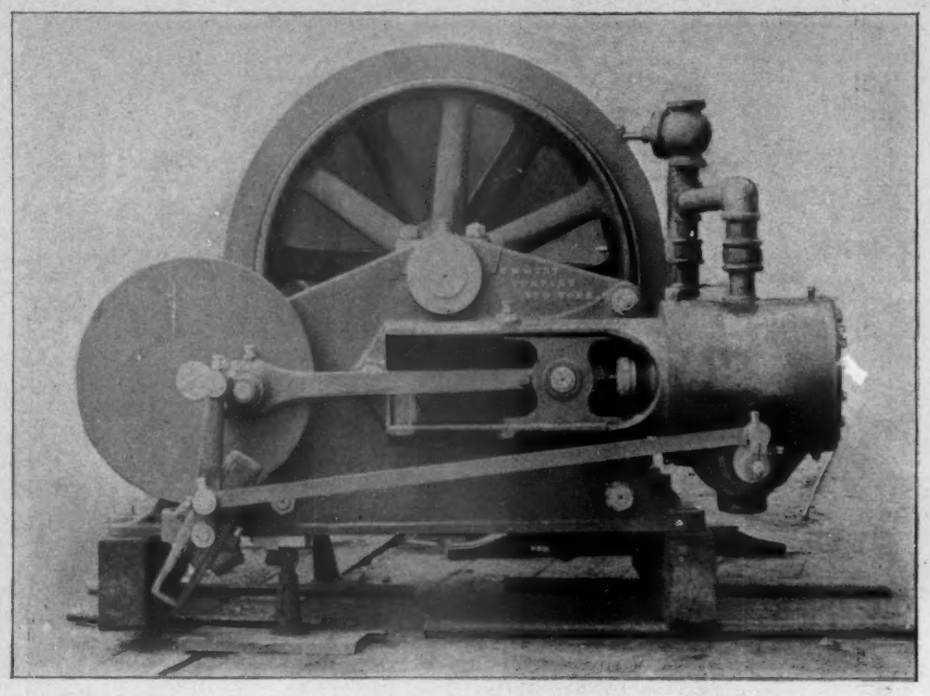


Fig. 2.

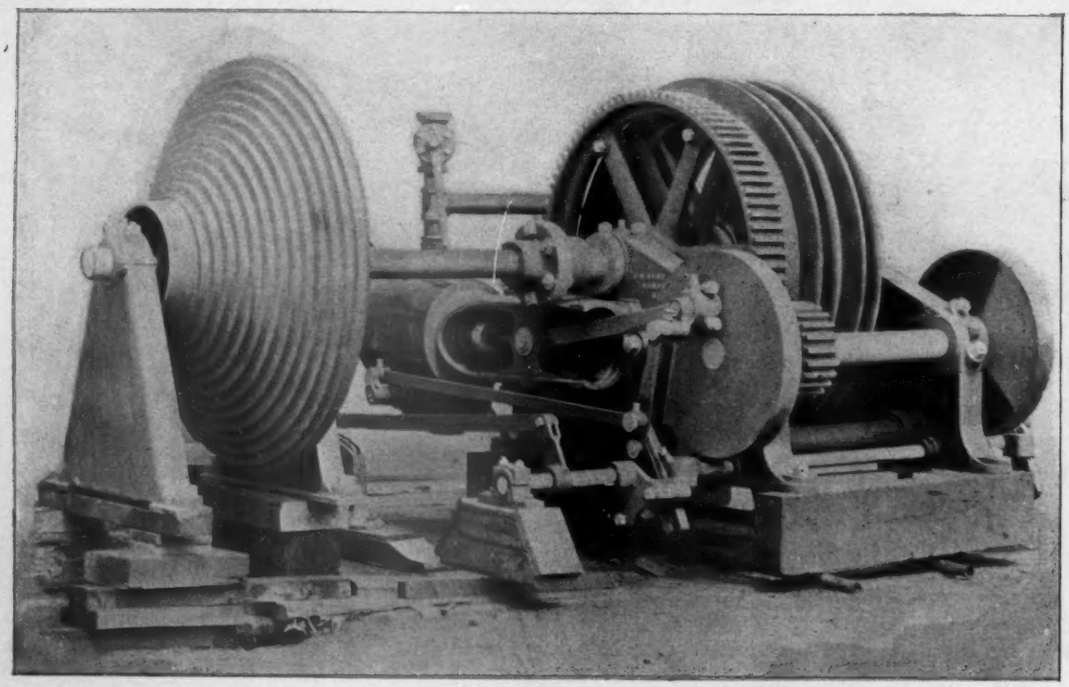


Fig. 3.—12 by 14 Inch Double Hoisting Engine.—Built by the C. W. Hunt Company, New York.

service of a fireman. Coal trimmers are needed in the barges only when the latter are so nearly unloaded that the coal cannot be reached by the steam shovel.

As already stated, the shovel has a capacity of two tons. It is operated by the double cylinder 12 by 14 inch hoisting engine in Figs. 2 and 3. The height to which the coal is lifted is about 75 feet, which is much greater than usual in this kind of a plant. The engine-room floor is 60 feet above the dock. The engine shaft is geared directly to the hoisting drum shaft, the whole arrangement being self-contained and compact. Several features of the engine are worthy of notice. The valve gear is one designed by Mr. C. W. Hunt, and is a modified Hackworth motion. It is very simple for a reversing gear, and consists of a connection, one end of which is carried on a return crank from the main crank pin, while the other end is attached to the sliding block of a straight link carried on a tumbling shaft. The upper end of this connection has a circular motion, and the lower end moves in a straight line, the direction of which is dependent upon the link. The valve rod is attached to the connection at a point near its lower end, and the movement of the valve is largely derived from the horizontal component of the motion of the lower end. It is evident that throwing the link over to the opposite angle from that shown will reverse the direction of valve travel, and thereby reverse the engine. The valve is located under the cylinder, and is cylindrical in form. In this position it permits perfect drainage from the cylinder.

The hoisting and dumping chains are wound on the drum between the two sets of flanges seen near the gear wheel in Fig. 3. The chain winds up on itself, so to speak, and the change of diameter resulting therefrom is compensated for at the counter-weight drum seen on the nearer end of the same shaft. The counter-weight is suspended within the tower by a wire rope, one end of which is fixed while the other is attached to the drum. The counter-weight is sufficient to approximately balance the weight of the empty bucket and reduces the maximum demand on the engine during the operation of hoisting. The counter-weight cable unwinds on the increasing circumference of the drum and thus balances the weight of the steam shovel at all points. This arrangement gives the minimum steam consumption per ton of coal hoisted as the work of hoisting and lowering shovel is done by the counter-weight. The hoisting chain winds on a drum between the pair of flanges of the spool nearest the large gear. This drum is fixed on the shaft and between its flanges and the gear is a band brake by which the engine can be stopped. The next spool is for the dumping chain and is loose on the shaft, and is driven by a friction which is strong enough to keep the chain taut at all times. When the shovel is to be dumped another band brake on this spool (not visible on the engraving) holds the dumping chain, which is attached to the apex of the shovel frame, and when the engine is reversed the shovel opens.

The shovel chains are of a novel construction which gives a

large bearing surface and great strength and safety. The links are each made up of a number of thin steel pieces stamped out of sheet steel. The chains pass over pulleys on a trolley that travels on the curved boom extended out from the front of the tower. When the shovel rises to the trolley, trolley and shovel travel together along the under side of the boom up into the tower where the contents are dumped into a hopper. In lowering, the trolley and shovel go out on the boom together until the trolley is arrested by a stop, after which the shovel decends vertically. The boom is fixed when the plant is in operation, but it can be swung to one side, allowing the masts

Fig. 4. Fig. 5.

Weight Box for Automatic Cars.—C. W. Hunt Company.

of a vessel to pass it when necessary. This arrangement of engine and booms allows the hoisting plant to be operated by one man who has complete control of the engine and the shovel.

The patented automatic cars used by C. W. Hunt Company in so many of their plants are probably familiar to a large number of our readers, but for the benefit of those not informed we will describe their operation. In this plant there are two narrow-gage tracks leading from the hoisting tower into the building, one track passing down each side of the building over the bins. There is one four-wheeled car for each track and the side doors of the cars swing on hinges at the top, and at this plant each holds a little more than a ton, so that one trip of each car delivers to the bins more than a ton of coal. Attached to the side side of one of the girders carrying the rails over the bins is a dumping block which strikes the latch mechanism of the cars as they pass: the side doors swing out and the coal falls in the bin. This dumping block can be shifted from one position to another so as to allow the car to dump in any desired pocket in the storage building.

The loaded cars run into the house by gravity, the tracks having just sufficient grade for this purpose. The mechanism by which they are returned automatically is ingenious and simple. Along each track are two wire ropes across which can be clamped a stop at any desired location. The loaded car as it goes down the track picks up this stop, takes it along with it, and draws the cable after it until its motion is arrested and its load is dumped. These cables are carried over pulleys to one corner of the weight box shown in Fig. 4, one upper corner being hinged to a fixed frame. These triangles, one for each track, are also to be seen in the second view of Fig. 1. When the car pulls the cable it lifts this box, which is heavily weighed, into the position shown in Fig. 5. As soon as the load is dumped the empty car is sent back to the loading point by the triangle as the latter returns to its normal position. Thus the dumping and return of the car are entirely automatic and by shifting the stop for the car and the dumping mechanism the car can be made to deposit its load in any desired bin.

A neat boiler-house has been erected on the dock and in it is a return tubular boiler 5½ feet by 16 feet, with 98 three-inch tubes It is rated at 100 horse-power.

There is a feature of the framing of the building and bins that deserves mention. It will be noticed from three views of Fig. 1 that on the outside there are four bands of heavy timbers. These are notched down over the ends of the timbers projecting through the sides, and all joints made so as to resist bulging under the weight of the coal in the bins. There are three passageways for coal teams under the bins and coal can be taken into wagons in any one of these passageways or from either side of the building. The chutes are operated from the wagon by the driver, and the trough of the chute has a bottom of netting through which the dust of the coal passes into dust bins located under the chutes.

This successful plant has a daily capacity of 600 to 700 tons of coal taken from the barge and delivered to the bins under normal working conditions; round trips of the bucket are frequently made by the engineer in 50 seconds, which, with a shovel holding two tons of coal, gives a maximum capacity greatly in excess of that amount.

The Construction and Condition of Mail Cars.

The annual report of the General Superintendent of the Railway Mail Service for the fiscal year ending June 30th, 1896, contains an interesting paragraph on the construction and condition of railway post-office cars. Statements received from all of the division superintendents show that the improvements made in car construction during the year covered by the report have been greater than for any similar period since the organization of the service. A large number of the railway post-office cars now in use are vestibuled, and in addition are provided with all modern improvements in the way of light, heat, couplings, buffers, etc. As a result, they pass through accidents more successfully than ever before, and the per cent. of the clerks killed and injured has been greatly reduced.

The report states that independent of improvements made in the construction of cars so as to increase their carrying and resisting power, the greatest improvement made has been in the character of the light. The total number of full railway post-office cars now in use is 778, all of which were formerly lighted by oil lamps, whereas at present 215, or 27 per cent., are lighted with Pintsch gas, which is regarded by the department as not only the best system for illuminating purposes, but also in the matter of the safety of the clerks and the mails in the event of accidents occurring to trains upon which clerks are assigned to duty. The number of cars heated by steam is 327, or 42 per cent. of the total.

An examination of the list of casualties contained in the report shows that while there has been a decrease in the number of instances in which mail matter was damaged by oil from the lamps, or actually destroyed by fire, resulting from this source or from the stoves, much annoyances and serious inconvenience is still caused by these troubles. There are 32 cases cited in which mail matter was damaged by oil from the lamps, three cases in which fire originated from the oil lamps, eight from the stoves and eight from causes not definitely known.

It is very gratifying to note that the Railway Mail Service Department has received the hearty co-operation of all important railway lines in the work of extending the application of safety devices to the mail cars, and that quite a number of companies who have not up to the present seen their way clear to the introduction of Pintsch gas, steam-heat, vestibules and other safety appliances are carefully considering the matter, many of them having determined to adopt these features at an early date. Since the safe transportation of the mails is of such vital importance to the business interests of the country, it is to be hoped that the work of strengthening and improving the mail cars will be rapidly carried forward, and that on the records of another year there will be fewer cases of loss of life to the clerks and of destruction or damage to the mails than ever before.

(Established 1832.)

AMERICAN ENGINEER
CAR BUILDER AND RAILROAD JOURNAL.

28TH YEAR. 66TH YEAR.

PUBLISHED MONTHLY
BY
R. M. VAN ARSDALE,
MORSE BUILDING.....NEW YORK.

M. N. FORNEY,
W. H. MARSHALL, } Editors.

R. G. CHASE, 705 Western Union Building, Chicago.

JANUARY, 1897.

Subscription.—$2.00 *a year for the United States and Canada;* $2.50 *a year to Foreign Countries embraced in the Universal Postal Union.*

EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Special Notice.—*As the* AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL *is printed and ready for mailing on the last day of the month, correspondence, advertisements, etc., intended for insertion must be received not later than the 25th day of each month.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

To Subscribers.—*The* AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL *is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied.* **When a subscriber changes his address** *he ought to notify this office at once, so that the paper may be sent to the proper destination.*

The paper may be obtained and subscriptions for it sent to the following agencies: **Chicago,** *Post Office News Co., 217 Dearborn Street.* **London, Eng.,** *Sampson Low, Marston & Co., Limited St. Dunstan's House, Fetter Lane, E. C.*

By the reversal of the decision of the Circuit Court in the St. Louis coupler suit, the right of steel and malleable iron companies to supply parts of couplers to railroads for repairs appears to be established. The only limitations are that the parts supplied shall not amount to a reconstruction of the coupler and that the part or parts furnished shall not be patented articles in themselves. In other words, though the replacement of a knuckle does not constitute reconstruction it can only be supplied when the patents do not claim the knuckle separately but only in combination with other parts; furthermore such knuckles must actually be used for repairs, and cannot be used with new heads or locks supplied by the same or other parties without constituting infringement.

Our readers may be interested to know that the decimal gage adopted by the Master Mechanics' Association, American Society of Mechanical Engineers, and several other societies, is receiving substantial recognition. Recently the American Steel Manufacturers Association adopted it and will hereafter use it to the exclusion of other gages. Several large railroads, notably the Pennsylvania and Southern Pacific have issued orders from the General Manager's offices that no other gage be used in the ordering of material. The Pratt & Whitney Company have completed 500 of these gages and are at work on the second 500. The tools for making the gages have been expensive and have required much skill in their design and construction. The greatest problem presented was due to the elliptical form of the gage and consisted in milling each of the slots in the circumference of the gage normal to the curve. But this and other problems have been solved satisfactorily and the gages will now be turned out with greater rapidity. Added to the undoubted merit of the decimal gage, the anxiety displayed in many quarters to obtain gages at an early date augers well for its general adoption and the ultimate abandonment of the divers gages now in use.

Last month we referred to the movement inaugurated by the Ohio Falls Car Manufacturing Company for the establishment of a standard box car incorporating the Master Car Builders' standards and recommended practices, this standard to be followed by the various car-building concerns when filling orders for small roads who do not furnish drawings or standards of their own. A communication on this subject to the Central Railroad Club met with a queer reception. It was laid on the table because it was considered to be an attempt to "anticipate the functions of the Master Car Builders' Association." The gentlemen who expressed this opinion ought to know better, and we must conclude that the project was not carefully considered by them, or such action would not have been taken. It is true, as stated, that the Master Car Builders "have been adopting standards for a great many years, and they have not designated all the standard parts of a freight car or its capacity," but that should not stand in the way of manufacturers undertaking to put the standards already adopted into more general use or to uniformly employ certain leading dimensions, not yet standardized, in their own practice. The plan rightly carried out has everything in its favor and is deserving of hearty support, and we cannot see how the dignity of the Master Car Builders' Association is going to suffer by it or its prerogatives be usurped. The circular letter which we received certainly gave due prominence to the work already accomplished by the association and made provision for a prompt recognition of anything it might do in the future. We are still of the opinion that the movement is a good one and we wish it complete success.

In 1897 those attending both the Master Car Builders' and Master Mechanics' conventions will be compelled to stay at Old Point Comfort for at least 10 days, or the longest of the periods over which the two conventions have been spread in recent years. Many times have the associations been urged to curtail the interval between the two conventions and a few years ago the sentiment in favor of it was so strong that it was expected a permanent change would result. The time was shortened in 1891 to six days, but since then change after change has been made and through it all the period has been growing steadily, as will be seen when we state that from 1890 to 1896 inclusive, the days occupied by the conventions have been ten, six, eight, nine, nine, nine and eight respectively, and in 1897 the number will be ten. These figures indicate a vacillating policy that is not particularly creditable, and the manner in which the by-laws relating to the date of the conventions have been changed seems to be free from all deliberation or serious thought. Quite a number of the members of both associations, men whose opinions we all respect, believe that unnecessary time lost between conventions is an injury to the associations, as it prevents many prominent railroad men from attending both conventions. If, instead of continuing to pursue the vacillating policy of the past the associations would next June appoint a joint committee to recommend some fixed programme for the two conventions and at the same time suggest such changes in the order of business, or amendments to the constitution and by-laws as will expedite the routine business, the two conventions can not only be held in much less time than ten days, but more and better work will be done in the shorter period than is now accomplished. If only two days out of ten are saved the result will be welcomed by many. With an average attendance of 1,200, the total saving in time would be 2,400 days or the equivalent of seven years of one man's time. If out of the

1,200 there are only 300 who are anxious to save time, it ought to be remembered that many of these 300 are men who are doing the best work in the associations, and whose roads have indirectly at least contributed much to the advancement of the societies through the experiments and investigations carried out on their lines and at their expense.

Besides the reduction of the time occupied by the routine business of the associations, another reform, needed more particularly in the Master Mechanics' Association, is the selection of better subjects for committee work. Just how this is to be brought about is not so important, but that better subjects are required is a settled conviction not only in our own minds but in those of several prominent members who have expressed their opinions to us. When the association investigates and takes action on such matters as a decimal gage, standard dimensions of tires, boiler steel and tube specifications, locomotive tests, proportions of exhaust pipes and nozzles, and others which might be mentioned, it usually does most creditable work—work that is appreciated not only in this country but abroad—but when it receives committee reports on petty details which could better be taken up in carefully prepared topical discussions, it detracts from its own dignity. Many of these reports on details of locomotive construction have been excellent and yet the committees reporting on them must have often felt that they were small matters on which to elaborate a formal report. These same committee men could have started valuable topical discussions on the details assigned them, without feeling that they were called upon to handle a small matter in a large way. It may not be easy to formulate a satisfactory rule for guidance in the selection of subjects for reports, but possibly as good a one as any would be to call for reports only on those subjects which, because of their general character or the time and expense required for their investigation, or for other good reasons, cannot be studied by each road individually, and to assign for topical discussion subjects less broad, and which most roads can investigate in part for themselves, or on which they can gain some experience in the course of regular operation.

There are excellent prospects of an extensive addition in the near future to the world's experience and knowledge of the merits of water-tube boilers for all kinds of marine purposes. Much of this added experience will be derived from the navies of various nations, for at the present the installations of water-tube boilers on naval vessels range from those on small torpedo boats to the 25,000 horse-power in the British cruiser *Powerful*, and include a number of the prominent and successful types. In the size of the individual boilers installed there is also a wide range, the largest running into thousands of horse-power. In the merchant service there are many modern vessels fitted with water-tube boilers, some of them running along our Atlantic coast, others on the great lakes, while British and Continental yards have fitted ocean-going steamers with these boilers. There is of necessity a great difference in the construction of water-tube boilers for cruisers and for that class of vessels of which the destroyers head the list. Boilers for the latter must be of the lightest possible construction, and produce the maximum of horse power from the minimum of space. The result of these demands has been the production of boilers that exhibit the highest engineering skill, but are of a lighter construction than would be desirable for large merchant vessels. The boilers in large cruisers need not be extremely light, and in all respects they approach more nearly to what would be required for large ocean steamers. For this reason the merchant marine, while watching with interest the performance of all water tube boilers in the navies of the world, will be specially interested in the boilers of these large men-of-war. The experience gained from them, added to the records obtainable from the merchant vessels similarly equipped, will in a few years provide much valuable information for the guidance of those concerned in the construction and operation of large steamers. And it will not be surprising if in the same period the merits of the water-tube boiler should bring them into extensive use for small steamers, yachts, and craft other than ocean-going steamers.

THE ENGINEER IN NAVAL WARFARE.

The December number of the *North American Review* contains a symposium on "The Engineer in Naval Warfare," the several articles of which have been written by Rear Admiral J. G. Walker, Captain A. T. Mahan, Captain R. D. Evans, and Lieut. S. A. Stanton, all of the United States Navy. These officers have submitted their various contributions as the substantial argument of the line branch against increasing the number and improving the status of the Naval Engineer Corps. One would be justified in expecting from such officials a dignified and pertinent discussion of the long existing controversy between the sailors and the engineers of our navy; but the real issues of the struggle have only been lightly touched upon, and the several contributors seem to have made a concerted effort to imply that the naval engineers desire command of the vessels, and seek honors to which they are not entitled. It is a significant fact, one that testifies to the weakness of the position of the line in this controversy, that in all their contributions to the discussion of it only two arguments--if they can be called arguments--have been advanced; the first charges the engineer with an attempt to get command of more than his department—a charge that has repeatedly been shown to be false; the second takes the form of strenuous pleas for the maintenance of "military organization" without a single definite statement of how that military organization is endangered by the proposed reforms. The symposium in the *North American Review* is only a reiteration of these charges and specious pleadings.

SPECIOUS PLEA OF THE LINE.

Except the dignified discussion of Captain Mahan, the tone of all the articles is narrow and unpleasant, and will tend to give the country a less exalted opinion of the men who practically control our naval organization. Captain Mahan attempts to handle this subject through the same processes of reasoning and statement which have made his style of writing famous. The claims of the naval engineers, however, are of too practical a nature and too deeply concern the usefulness of the service for even Captain Mahan to controvert by specious pleas and attractive charm of diction. Like all the other contributors to the symposium, Captain Mahan is exceedingly anxious that military titles shall be withheld from the engineers.

Rear-Admiral Walker practically commences his article by declaring that he "has not taken part in the so-called Line and Staff controversy." The press dispatches of the past 20 years show that the Admiral has been a recognized leader of the line forces, and has appeared before successive Congressional commttees as the leading representative of that faction. There may be a question in the minds of many people as to whether even an Admiral with a memory so faulty in regard to his own acts is competent to discuss broadly a problem involving important matters in the lives of others. A man with such a distressing infirmity is liable to make serious mistakes, and in this case that fact doubtless explains why the Admiral has made many surprising statements. He charges the naval engineers with proclaiming "that engineering is now the leading science, and the care and management of steam machinery the leading art, of naval warfare"—a declaration that has never been made by the engineers, and which the Admiral ought to know does not represent the views of the engineers.

The Admiral then pleasantly reviews his career of 46 years in the navy, and does not fail to remind us that he has "reached the highest rank in the navy"; that part of his extensive experience has been gained "as Admiral in command of a fleet," and that he has rounded out his education by a study of foreign naval systems. Having given his readers this gratifying information, so germane to a discussion of this kind, he indulges in truisms and platitudes concerning the necessity of military discipline and training that are disputed by no one. He tells us that "a navy exists for war alone"; that "it is essentially a military organization in time of war," and should be one in time of peace; that military training and military knowledge are of importance, etc., etc. All of this is very, very evident, even to a civilian, but where does it touch on the rights of engineers, or on the

present controversy? The civilian expert knows the value of training and discipline. He also knows what the Admiral apparently does not (perhaps he has forgotten it)—that the success and efficiency of any extensive organization depends in great measure upon the maner in which each and every man is made to feel that he is an essential part of it. In attempting to belittle the work of the engineer, and in ridiculing his claim to official recognition, the Admiral does much to make the engineer officer even more discontented than he has been in the past. He also does much to destroy that very discipline which he prates so perfunctorily about.

Can the Admiral do anything more to foster the discontent already existing? Can any one be blind to the studied insult of such statements as: "In the business of warfare the men who direct the operations of war and handle the weapons of war are those upon whom the success of war depends"; and "the duties of those who do not take a distinctly military part, while necessary and important, are adjunct and essentially subordinate." Are these statements even true? The *Engineer*, a great English journal, than which there is none more capable of intelligently discussing naval matters, says in its issue of Feb. 7, 1896: "The truth will have to be recognized that without the engineer, the admiral, the captain, the blue-jacket, the whole executive branch of the service are useless. The naval supremacy of Great Britatn *rests in the hands of the engineers.* . . Mr. Goshen must take steps to add to the number of engineers." And our contemporary distinctly says in another part of the article quoted that it is not engine drivers, not even merchant marine engineers, but specially trained and educated naval engineers that it is talking about.

Admiral Walker writes as though he had unanimous opinions of naval experts to back him up, whereas on every hand, in the service and out of it, in this country and abroad, we can find men who are positive that the duties of the engineers are now among the most important factors in naval operations.

HOSTILE AND BITTER ATTITUDE OF THE LINE.

The contribution by Capt. R. D. Evans opens with a slur upon Engineer-in-Chief Melville, whom the engineering world recognizes as in many respects the most distinguished man in the naval service. This is followed by a charge of inefficiency of the engineering force in general, and a magnificent tribute to his own achievements when in command successively of three of our modern ships. His article covers six pages, of which two are devoted to what he accomplished as commander of the *Yorktown*, *New York* and *Indiana*. If we are to take him seriously, the only drawback to still greater achievements by him was the faultiness of our naval machinery and the incapacity and insubordination of the engineer's division detailed to his ships. He furnishes nothing worthy of discussion, but in his closing paragraphs he tells the country that the engineer is too much of a luxury on board ship and that is wanted in the engine-rooms are uneducated engine drivers. He would reduce the number of engineers and take into the service a corps of warranted machinists. Captain Evans was Admiral Walker's Fleet Captain, and therefore, like his chief, the prejudiced captain, indulges in slurs upon the Engineer Officers and their force of men. When the men below the protective deck are told that they may die in defense of the flag of their nation—because they are paid for it—they need no further evidence of the injustice practised against them.

What are we to think of a captain who points out the discontent that exists in a branch of the service, and then deliberately attempts to impress upon the men in that branch the belief that they have no share in the honors of war, in fact that they are only tolerated in the navy because there is some machinery on board our vessels which the line officers do not understand, and which they must therefore have men paid to operate?

The first sentence of Lieutenant Staunton's composition is characteristic of its general tenor. He commences as follows: "Twe ideas are assiduously advanced by the engineers; first, that they are the sole inheritors afloat of the genius of Watt and his fellow-pioneers in modern science and mechanism," etc. Such an unreasonable and untruthful assertion shows that this subordinate officer has contributed nothing of genuine value to the discussion. He states that "under their (the line officers) sole direction and guidance has been developed the manufacture of steel—the manufacture of armor which has led the world." He thus claims for the line officers credit which is justly due to the great manufacturers of the nation. Cast steel, structural steel and armor plate, torpedoes, projectiles and the rough forging for guns have been furnished entirely by private parties. The most prominent way in which line officers of the navy have figured in the steel industry has been the incompetent and disgraceful manner in which they have looked out for the interest of the government when acting as inspectors. If they had not attempted to usurp the duties of the naval engineers and naval constructors in the inspection of steel, the country would not have been humiliated by the armor fraud scandal, nor by such exhibitions of incapacity as is revealed in the press of last month, relative to material furnished for some of our vessels under construction.

OUR INEFFICIENT NAVAL ORDNANCE DEPARTMENT.

The manufacture of guns has been chiefly in the hands of the line officers. This policy has not been productive of good results, for while the largest rapid-fire guns in our navy are six-inch (and there are only a few of them), other navies are mounting rapid-fire guns up to and including eight inches. Other nations are obtaining greater muzzle velocities for nearly all calibers than are derived in our own practice. Other navies have developed wire-wound guns by which greater strength, less weight and ultimately less cost and time required for manufacture are attained. Our navy has done nothing in this respect—the army is experimenting with such a weapon. We do not say this in a spirit of reflection on our ordnance officers. We all know that private firms, with their facilities for experiment, and with some government encouragement, can always outstrip the governmental shops. Our ordnance will continue to be inferior to that of other nations until private firms in the United States manufacture heavy guns like Armstrong does at Elswick, Krupp at Essen, and Canet at Havre.

OUR INADEQUATE NAVAL ENGINEER CORPS.

If anything further is needed to show the unreliable character of Lieutenant Staunton's article it can be found in his comparison of of the engineers of the British and American navies based upon the number of ships possessed by each nation. The numbers are valueless without a statement of the character of the vessels that compose the table. He knows, although his readers do not, that the English list includes yachts, store, surveying, sailing, training and harbor ships. He also knows that it includes 150 vessels laid up in reserve. Furthermore he says not a word about the number of engineers in the British navy being too small for the ships in commission. It is a fact nevertheless. *The Engineer*, Feb. 7, 1896, says: "We beg our readers to turn to the *Engineer* of March 8, 1895. In it they will find an elaborate setting forth of the Admiralty distribution of engineers in the fleet. . . . The principal fact is that last March there were 318 engineers needed and only 85 available. . . . We have not engineers enough for the ships we now have; whence are they to be had for the large additions that must be made to our fleet?" Lieut. Staunton has not told his readers that in the report of the Secretary of the Navy Mr. Herbert officially states that the United States possesses 73 ships, while Great Britian has 493. Nor does he state that there are 1760 commissioned line officers in the British service, and 723 in the United States navy, in other words that the United States has 9.9 line officers per ship, while in the English service there are only 3.52 officers per ship. It is incredible that men belonging to a profession wherein the standard of honor has always been regarded of high order should half tell the truth as Lieutenant Staunton has done.

Based upon such false and misleading tables, all the contributors, with the exception of Captain Mahan, demand that the number of engineers should be reduced. Their views are not in accord with the experience and study of the honorable secretary of the navy, for in Mr. Herbert's annual report to the President, page 43, he urges the augmentation of the Corps of Naval Engineers "until the limit shall be 250 instead of 194 as at present."

OFFICIAL RELATION OF THE CHIEF ENGINEER TO THE COMMANDING OFFICER.

Captain Mahan's article is the only one of the four that is wisely tolerant of the views of the engineer. His whole argument is a defense of the military organization on board ship. He shows that the line is naturally the directive power, and as such must command. Its position above the protective deck in contradistinction to the location of the engineers below that structure places the power of command with the line branch. Captain Mahan declares that the engineer "recognizes the captain. but resents the executive officer and the officer of the watch. The spirit, however, is one." Does Captain Mahan contend that in the army there can be a trinity composed of the commander of the post, the adjutant of the battalion, and the officer of the day, all vested with authority to assume at will to direct the administration of the garrison? Is not the directive power concentrated in the senior line officer present?

Of course the naval engineers resent the claim that a trinity of men on board ship can each assume command prerogatives. The engineers acknowledge that the succession to command is lodged in the line officers, but they do maintain that the inheritance cannot be assumed by anyone so long as the captain is on board ship and fit for duty. The representative of the captain will be implicitly obeyed in any order that he may convey, but such a messenger cannot assume other command prerogatives. In the controversy which has resulted there has never been a hint from the engineer against the authority of the commanding officer, or the prompt obedience to a signal from the bridge, even if that signal be made by a powder boy. Sections 10 and 17 of the Wilson Engineering and Educational bill, which is in full accord with the views of the engineers, prove the sincerity of their unqualified recognition of the commander as the supreme authority.

It is not the desire of the engineers to command ships. They are striving to command the men of their own department, subject alone to the authority of the commanding officer. They demand that they shall be placed upon an equality with officers of the line in performing their duty.

NECESSITY FOR TRAINED ENGINEER OFFICERS ON BOARD SHIP.

With the exception of Captain Mahan—and even he implies the thought—the several contributors maintain that the engineer officer is virtually an engine-driver when he goes on board a warship. It will surprise the engineering world to be told that the expert in charge of the complicated machinery of modern ships of war is thus regarded by the commanding officers of the American Navy. It must be a trained mind which is able to superintend the efficient working of machinery costing over one and one-half million dollars. The line officers insist that the small amount of machinery in their charge should be under the administration of technically educated line officers with titles and rank that are genuine, but they urge that all the remainder of a vessel's machinery, including its great propelling engines and its boilers, together with all the men needed in their operation, shall be taken from the care of highly-educated engineers and shall be placed in the keeping of uneducated engine-drivers without title, rank or authority.

There are men in the Congress of the United States who would take good care that no more money should be appropriated for ships-of-war if the care of the machinery was to be intrusted to engine-drivers and not to highly trained experts. The progressive and excessive cost of repairs to our warships can be easily accounted for, if all the commanders of our vessels hold such views. Demoralization and discontent must reign supreme if our naval commanders accord such a status to the engineer officers.

Without going further into this controversy, we find the situation as follows: The country has thus far acted on the assumption that educated engineers are needed on our modern warships. To secure such men they have been educated at Annapolis at a a cost of $15,000 per graduate. To retain such experts when it does secure them, it must make the engineer's positions on shipboard more tolerable than the existing organization provides. The engineer's duties are chiefly those of superintendence in their department, and the executive duties belonging to it, and their authority should be sufficient to free them and their men from unnecessary petty annoyances. Having placed engineers of education and high attainments on board our ships, must it now be confessed that it is impossible to accord them the status of officers? Must the efficiency of their department be sacrificed in order that the traditional customs of the service be preserved? A large and efficient force of engine-drivers must be secured, but their work can only be satisfactorily performed under the guidance and direction of a trained corps of educated and scientific experts.

RANKS AND TITLE IN OUR NAVAL ORGANIZATION.

The staff of the navy demand to be placed on an equality with the staff of the army. The naval engineer is entitled to official recognition and military titles should not be withheld from them.

Title simply designates and unqualifiedly acknowledges rank. The line of the navy has attempted to use it as a patent of official superiority and as a license for privilege. The coddling of one set of officers, as regards pay, rank, title, position, power, privileges, to the neglect of other officers whose duties are in many respects as important, is a certain way of securing inferior talent and character. It invites defeat in the issue of battle, for which alone navies exist. The good of the commonwealth should be the sole consideration, against which naval traditions, usages, jealousies, and the desire to obtain all the advantages, prestige and emoluments of the naval service, should be urged in vain. This favoritism to the line can only be secured by a corresponding injury to the navy as a national weapon.

DEFECTS AND IMPROVEMENTS IN LOCOMOTIVES.

In the first article on this subject, which was published in the September number, reference was made to steam superheaters as a means of saving and utilizing some of the heat which now escapes up the chimneys of locomotives. The economy which is possible by superheating steam, like that resulting from heating the feed-water, has long been known, and innumerable experiments have been made and appliances devised for securing the economy which would be available if the practical difficulties could be overcome. Heretofore these have been chiefly due to the high temperature of the steam, and the consequent destruction of the lubricating material by the hot steam. This trouble could be assigned to three causes; first, to the difficulty of regulating the temperature of the steam; second, to the use of vegetable packing, and, third, to the fact that the animal oils, used for lubrication before mineral oils were generally introduced, were disentegrated or decomposed at comparatively low temperatures. Recently, renewed attention has been given to this subject, especially on the continent of Europe. Some of the mineral oils, as is well known, will stand a much higher degree of heat than the old animal lubricants would, and the same thing is true of metallic packing compared with that formed of hemp and other similar materials. Steam of a higher temperature may therefore be used now than was possible when the cylinders and valves were lubricated with animal oils. The problem, too, has been attacked from the other end, that is by providing means for regulating the temperature of the steam after it is superheated and preventing it from entering the cylinders at an excessively high degree of heat. The methods of this will be discussed farther on.

The difficulties of superheating may be understood if it is realized that a modern express engine, running at the rate of 60 miles per hour, cutting off at one-third of the stroke, uses about 1,260 cubic feet of steam per mile and per minute, or 21 cubic feet per second. A given volume of steam, it must be remembered, will not absorb heat as rapidly as the same volume of water will. The sensible temperature of steam of 170 pounds pressure is 375 degrees and it also contains 852 degrees of latent heat, or heat of gasification, as some have called it. The specific heat of steam is less than half that of water, or, in other words, it will take less than half as much heat to raise the temperature of a given weight, say a pound, of steam one degree as would be required to heat a pound of water one degree. For each degree that dry steam is superheated its pressure is increased .00236, or for each 100 degrees its pressure will be increased .236 and 200 degrees .472.

That is, dry saturated steam of 170 pounds pressure if super-

heated 110 degrees, would be increased to 210 pounds pressure, and if superheated 200 degrees its pressure would be 250 pounds. But the total heat in a pound of saturated steam is 1,227 units. As it takes less than half as much heat to raise the temperature of steam a given number of degrees, as is required to heat water to the same extent, it will be seen that somewhat less than 50 units of heat will increase the temperature of a pound of steam above 100 degrees, and its pressure 40 pounds, and 200 units will add 100 degrees to the heat and 80 pounds to the pressure. That is an addition of 8.15 per cent. of heat increases the pressure 23½ per cent., and the addition of 16.3 per cent. of heat increases the pressure 47 per cent. It is not pretended that these figures cover the whole theory of superheating, but they indicate the source of its economy.

Now that this theoretical saving is, at least in part, realizable in practice, has often been shown, but especially in recent experiments made with stationary engines in Switzerland and Germany. Thus the *Bulletin de la Societe Industrielle de Mulhouse*, for April-May, 1896, reports that a compound engine was tested in Alsace recently, in which the mean steam pressure was 5.7 atmosphere (85.5 pounds), with the following results:

Steam Superheated.	Economy of coal.
107.6° F.	8 per cent.
183.2° F.	14.4 per cent.
212° F.	20 per cent.

That is, the figures in the first instance indicate that in that experiment about one-half the theoretical economy indicated by our figures was actually realized in coal consumption, and in the last about two-thirds. There must of course be a counter charge against this saving for the first cost and maintenance of the super-heating apparatus, and all experience teaches that this may consume all the saving, and more too, but the problem which it is intended to present here is the practicability of devising an apparatus which will effect this economy without a cost which will make it unprofitable. There can be no doubt that such an economy is possible ; the only question is whether it can be effected without costing more than it is worth.

At any rate it will be worth while to consider what must be done, and the means required to do it, in order to superheat the steam consumed by a modern express engine, which uses 1,260 cubic feet of steam of 170 pounds pressure per minute. The weight of a cubic foot of steam, of that pressure, is .4142 pound, so that we have a total of 521.8 pounds of steam to be superheated per minute. As it takes somewhat less than a half a unit of heat to superheat each pound of steam one degree, we must be prepared to transmit about 25,000 units of heat per minute from the products of combustion to the steam to superheat it 100 degrees or 50,000 units to heat it 200 degrees. Unfortunately our information and knowledge of the laws governing the transmission of heat to steam are not very exact or reliable. A locomotive of the kind which has here been taken as an illustration would have about 1,800 square feet of heating surface, and it consumes 521.8 pounds of steam per minute and must of course convert that quantity of water into steam. The total heat in this steam is equal to about 600,000 units, so that about 333 units of heat must be transmitted to the water per square foot of heating surface per minute. When a locomotive is working hard the fire in the firebox has a dazzling white appearance, the temperature of which is about 2,800° F. At the same time the products of combustion escape into the smokebox at a temperature of about 800 degrees. If we take a mean of the difference or 1,000 degrees and add it to the smokebox temperature we will have 1,800 degrees as the average temperature at the heating surfaces in the boiler of the locomotive. As the water and steam in the boiler have a sensible temperature of 375 degrees the difference between the heat on the fire side and that on the wet transmitting surfaces, would be equal to 1,800 — 375 = 1,425 degrees. Consequently on these hypotheses about one quarter of a unit of heat is transmitted per square foot of heating surface per minute per degree of difference of temperature. Taking the smoke-box temperature at 800 degrees and that of the steam to be superheated at 375 degrees and the same rate of transmission per degree per square foot per minute in a superheater that has been calculated for the boiler and we would have a transmission of a little over 100 units of heat per minute.

To increase the temperature of the steam 200 degrees it has shown will require the transmission of about 50,000 units of heat per minnte, so that our superheater must have about 500 square feet of surface. Now, it must be admitted that it will not be easy to provide that amount of heating surface in the smoke-box of a locomotive, which seems to be the only available location for it. Then it also seems certain that the rate of transmission of heat from the products of combustion in one side of a plate or a tube to steam in the other will be slower than it is if the medium through which the heat must pass is in contact with water; in fact the rate of transmission of heat in a superheater is given by Longridge at only one-twelfth of a unit per square foot of surface per minute per degree of difference of temperature. If this is correct a much larger amount of heating surface will be required in a superheater for the transmission of a given amount of heat than is needed in a boiler.

Nw these difficulties are pointed out not for the purpose of proving that the problem is insoluble, and that an effective superheater for locomotives is impracticable, but for the purpose of showing the difficulties which must be overcome. Unfortunately, too, in addition to these, there are some others. If the amount of heating surface which is required in the superheater is provided, one of two things is liable to occur when steam is shut off. If the superheater is then filled with steam it is liable to be treated to a very high temperature, while it is quiescent in the heater. If the throttle valve is so arranged that when steam is shut off from the engine it is also shut off from the superheater, the latter will then become heated to a high temperature, so that the first steam which the passes through thereafter will be liable to be overheated. As was pointed out at the beginning of this article, the regulation of the temperature of superheated steam has always been a difficulty in using it. Two methods of overcoming this difficulty have been suggested and employed, one to carry the hot steam after it has been superheated through pipes in the steam space in the boiler, so that any excessive heat is imparted to the steam in the boiler outside of the pipes. Of course, what may be called the superheat in the steam inside of the pipes would never all be imparted to the saturated steam outside of them. The hot steam would always retain some of its superheat, but the higher its temperature the greater would be the rate of transmission from the steam inside to that outside of the pipes. In this way any excessive heat would be imparted to that in the boiler the temperature of which could never get above that of saturated steam of boiler pressure.

Another method of tempering the heat of superheated steam is to first use it as a steam-jacket around the cylinders, by which any excessive heat would be absorbed. It has been shown that each of these two methods has been very effective in stationary engines, and there is no theoretical reason why they are not equally applicable to locomotives. The difficulties are all of a practical character—that is, to find room for the heating surfaces required and designing and constructing them in such a way that they will not be liable to fail at critical times or cost too much, or require expenses of maintenance which will absorb all the saving of fuel. There can be no question, however, that a theoretical saving of from 10 to 20 per cent. is possible by the use of superheated steam. This, and more, too, has been realized in practice. It is given at from 10 to 50 per cent. by Professor Thurston in his paper on superheated steam, read before the St. Louis meeting of the Mechanical Engineers last May. He also quotes from Mr. Donkin, than whom there is no better authority, who said that "no possible improvement of the steam-engine, of which we have any knowledge at this moment, offers anything like so great a chance of important economy as the introduction of superheating, and especially of superheating to at least 100 degrees or more above the saturation temperature of the steam."

The only question is the cost of effecting such economy. To persons of an ingenious turn of mind, with plenty of experience, and having besides what may be called *iron horse* sense, it is an inviting field for the exercise of invention.

Any one attacking this or any other problem in locomotive improvement should remember, though, that success here, as elsewhere in this field, will always be subordinated to the fact that the chief end of a locomotive is to haul trains, and not save fuel or make good indicator diagrams. Primarily it must haul its train without delay or interruption. If it can do this, and save coal and make good indicator diagrams at the same time, so much better, but if a railroad manager must choose between a locomotive which can haul its trains regularly and promptly, and yet is wasteful of fuel, and makes indicator diagrams resembling an old pair of boots very much down at the heel, or one which must be laid up for repairs from time to time, although it is as economical of fuel as a miser is of money, and whose indicator diagrams would delight the heart of a professor of engineering in a technical college, the railroad manager is sure to prefer the more reliable although more expensive machine.

THE TRAINING WHICH APPRENTICES NEED.

The report on apprentices presented to the Master Mechanics' Association last June has apparently been the means of directing attention to the education of young men in our railroad shops, and several papers and discussions before technical societies and railroad clubs attest the genuineness of the interest displayed. A peculiarity of much that has been suggested for the improvement of the apprentice is that it follows the lines of a more or less thorough technical training. The plans seem to be put forth with the belief that the present shop training is satisfactory, or that the technical training proposed will correct its shortcomings. The spirit in which these suggestions are made is most worthy, for, though some things done for apprentices may yield a good financial return, such educational schemes as have been outlined call for an outlay by the employer from which others will often reap the benefit.

Recognizing this excellent spirit of helpfulness toward apprentices, we nevertheless cannot agree with those who propose the educational courses outside of the shop work proper as the first step to be taken. As long as shop training is what it is at present, an offer of technical education to the average apprentice is like giving him a stone when he asks for bread. The stone may in this case be offered in good faith, but his digestive organs are not capable of dealing with it, nor is it the kind of food he craves. What he wants first, and what he has a right to expect, is to be taught those things necessary to proficiency in the trade he has selected. If he has ambitions to become more than a mere journeyman that is his affair, and he may generally be counted upon to fulfill those ambitions without direct help from his employer, though assistance from that source, if given, may be gratefully appreciated and will reflect credit on the giver. But the shop training is something which his employer has *contracted* to furnish him. His pay as an apprentice is to consist of two things—a course of instruction in the trade he has chosen and a small sum of money, made small because of the expense, direct and indirect, incurred by the employer in providing the instruction. Now the first question to be answered in any case before further training is considered is, "Does the employer faithfully discharge the obligations he is already under to his apprentices?" Is he giving them a proper shop training?" In how many shops can these questions be answered in the affirmative? Not many, we fear.

In a recent discussion of this subject before the Western Railway Club, Mr. Wm. Forsyth, Mechanical Engineer of the C., B. & Q. R. R., made an excellent plea for the apprentice when he said:

"They (those advocating a technical training) have gone beyond the practical training of the apprentice, and they have undertaken to set up a technical school in our railroad shops. I do not believe that this is the first thing to do. I do not believe it is the most important thing to do, for I think that nearly every railroad shop has in its superintendent of motive power and in its foreman the opportunity to do a good work for the apprentice boy, but they are shirking it, they are avoiding it. When I was learning my trade I was given an old lathe, with a worn-out lead screw, and a rickerty tail-stock and a slippery belt, and I was kept there turning bolts for several months. The foreman did not take any interest in me, there was nobody in the shop who tried to teach me anything, and if I learned anything it was because a boy absorbs something from his surroundings in four years, and he may be able to pick up something for himself if nobody helps him. That really is the condition of the apprentice boy of most railroad shops in this country to-day. So that if we want to do anything to help him, do not start with an ambitious scheme of giving him a technical education, but let us look after him a little in the shop, and in the first place try and make a good mechanic of him. As a practical suggestion in this line I should think we ought to try and find some one in our shops who is a natural teacher, if we can, some good mechanic who has a faculty of imparting knowledge to others, and let him have some oversight of the apprentices. Let him be one that they can go to and ask questions, find out something about what they are working at, and after that establish a class of some kind and get started at a night school and gradually develop an attempt at education."

Does not this quotation suggest the true course? Is not a complete shop training the very thing to obtain which the apprentices entered the shop, and for which they contracted with their employers? Is it not the essential thing to most of them, in view of the future they have planned for themselves?

Most of the young men enter the shop with the intention of becoming journeymen—nothing more. Anything that will tend to make them better mechanics is to be encouraged. But the prime requisite is what in brief we designate as shop training. Mr. Forsyth has given his experience as an apprentice, and many others can give similar testimony as to the neglect of foremen and others to instruct them. The writer's own recollection is that he never was given a change of work without having to "kick" in order to get it. There is such an admirable opportunity in the shop to instruct a youth in more than the mere drudgery of his occupation that it is a pity to see it neglected. But neglected it is. It is not exaggeration to say that the average apprentice drags through a three or four years' term of service wholly dependent upon his own unaided efforts in absorbing knowledge, neglected by the foreman, assigned to the poorest work and the most decrepit machinery; seldom fully instructed as to how any piece of work should be done, and without an opportunity to gain an insight to general shop methods or to show what he is made of. The only piece of work that the writer remembers spoiling during his apprenticeship was spoiled because of the careless instructions of a foreman. He was told to perform the last operation on a rather costly piece of work by a method of measurement that could only be right when all previous operations on the work had been accurately performed. As bad luck would have it, somebody had blundered by a quarter of an inch at a point that was not essential in itself, but which used as a starting point for the final operation, led to the ruin of the piece. In this case the apprentice learned to check other people's work before he trusted it implicitly, and furthermore, that there was a right and a wrong way to measure work; but he found it out without the aid of the man who should have been his careful instructor, and at the expense of the company.

When a boy is given a piece of work that is new to him, it would save the foreman much future trouble and greatly encourage the boy if he was told all there was to be known regarding the seperate operations and the why and wherefore of each move. But this is seldom done. As an example let us suppose that the boy is given his first piece of taper work. How is he told to go about it?

The chances are that the tail-stock is set over by judgement merely and several trial cuts taken, whereas it could be set over by calculation to almost the correct position. The apprentice is not told that if the drawing calls for a taper of one-quarter inch in six inches and the work is 21 inches long over all, the tail-stock can be set over $\frac{7}{8}$ inch and will be in approximately correct position. Nor is he told to keep the tool the same height with relation to the centers during the entire job until he has spoiled a piece of work by failing to do so, or, if so instructed, he is not told the why and wherefore. Here is a case where if the foreman had taken the time and interest to properly instruct the apprentice, the latter would have had some practice in arithmetic and geometry without going outside of the shop to receive it. He would

also have been taught to think for himself. And the number of such cases is legion.

Instructions of this character are only cited to show that many of them are incomplete and misleading. One of the most frequent mistakes made is to ignore the fact that the average boy has not learned to think for himself or to make a practical application of his knowledge. A little encouragement and a drawing out of the young man in the early part of his apprenticeship when he is enthusiastic will give him the right start and will repay both foreman and employer by the enhanced value of his services later on. He should be instructed in the reading of drawings, in which he is generally woefully deficient. In a recent issue of *Cassier's Magazine*, the editor says:

"It may appear as a curious fact that many men who have had years of experience in shops and who are good workmen seem to be afraid of drawings. While working to them with accuracy and finishing their jobs satisfactorily they never seem quite at rest in regard to the meaning of their drawings, and frequently remark: 'If I had another job of the same kind to do I could get through it in much less time.' This means, practically, that if they had a model before them instead of a drawing they could turn out their work more easily. It raises the question, too, whether it would not pay to give more attention to making drawings plain and to teaching the men to read them. Shading of parts and increasing the pictorial effect in general, so as to make one piece stand away from another, would seem to be a good thing, and in this respect some of the older forms of shop drawings might well be taken as examples worth following. To-day many of these out-of-date drawings are considered as having been wasteful of drawing-office time and uselessly elaborate, and yet they had good points. They told their story in a way quite foreign to the modern blue print."

And yet blue prints have come to stay, and the apprentice should be instructed in the reading of them. Another course of instruction never open to apprentices is that which pertains to the general principles underlying shop practice and methods. He learns how to perform certain operations at the bench, on the lathe, planer, boring mill or other machine, but he is never given a broader insight into the work of the shop.

If those who would inaugurate a movement toward a higher education among apprentices will consult with a few foremen or level-headed journeymen who take an interest in the apprentices and are fitted to speak of their needs they will be surprised to learn of the eagerness with which these boys seek instruction in reading drawings and in practical matters that could be imparted daily in connection with their routine work. This want, we reaffirm, is the first one to be satisfied, and having taken care of the apprentice in the shops. the evening drawing class and other courses of instruction can then be provided (and we think they should be provided) when they will be better attended and will yield better results.

There are to-day so many well-educated young men seeking a practical course to supplement a college or technical training that it is proper to put them in a separate class by themselves. They will need no instruction in drawing, mathematics, physics, etc., but will require a special shop course, better adapted to their future course as engineers or specialists rather than journeymen. This is not an apprenticeship proper, for its object is not to teach a man a trade. And yet these young men can usually bring such talents and knowledge to their work that it will pay a railroad company or manufacturer to admit them to their shops and give them the course they seek. Such an arrangement is a special one, and is bound to vary with the circumstances.

What is, therefore, needed for the regular apprentice is thorough instruction in the shop and in shop matters. This is the first and great essential. Then the other lines of instruction, such as evening classes in drawing, etc., may be undertaken, and where this is done we believe the employer will not only have the satisfaction of carrying on a good work among his fellow-men, but he will reap an immediate reward in the greater value of the services of his apprentices and in their loyalty to his interests.

Gen. W. W. Duffield, Superintendent of the United States Coast and Geodetic Survey, has announced the completion of the transcontinental triangulation along the 39th parallel of latitude. The line extends from Cape May on the Atlantic to Point Arena, Cal., on the Pacific, and is 2,625 statute miles in length.

Notes.

In an article on "the fastest train in the world," *Engineering* gives the particulars of a trip of one of the regular trains on the Caledonian Railway. The time table of this road now contains the schedules of nine trains averaging over 55 miles per hour, two of which reach the average speed of 60.9 miles per hour. In 1884 the time occupied by the quickest train between Carlisle and Aberdeen was 7 hours and 22 minntes; to-day it is 4 hours and 31 minutes. The train which our contemporary timed consisted of three composite cars, one sleeper and one van, all carried on four-wheeled trucks. The weight is not given. From Carlisle to Perth the train was hauled by an engine of the "Dunaclaster" type, with two pairs of drivers 6 feet 6 inches in diameter, a leading four-wheeled truck, and 18½ by 26 inches cylinders. The average speeds are given in the accompanying table:

	Miles.	Chains.	Min.	Sec.
Carlisle to Sterling	117	60 in.	119	5 = 59.3
Sterling to Perth	33	2 "	33	30 = 59.1
Perth to Forfar	32	40 "	32	1½ = 60.8
Forfar to Aberdeen (tickets)	57	10 "	63	40 = 53 7
Rockliffe to Bannockburn	111	25 "	110	40 = 60.3
Cargill to Kirriemuir Junction	18	26 "	15	42 = 70.1
Elvanfoot to Strawfrank Junction	20	43 "	16	55 = 72 8

As already stated this is a regular run and has been made nightly for many months.

Curious defect has been discovered in the Buda Pesth underground railway. There are not enough ventilating apertures in the tunnel and the trains rushing through it compress the air in it like that in the tube of a Zalinski pneumatic gun. On some occasions the cars are said to have been lifted from the track and the passengers have been almost suffocated. One stretch of tunnel, two miles long, has only a single ventilating aperture, making it almost an air-tight compartment.—*Engineer.*

A correspondent in the *Practical Engineer* says that on the Midland Railway, in England, no complete examination is made of a new locomotive boiler for five years, and even then it is the greatest rarity for a firebox to require patching. A few short stays to be replaced, and perhaps the firehole ring rivets, owing to the heads being burnt, is the sum total of the repairs usually required.

At a recent meeting of the German Institute of Gas and Water Engineers in Berlin, a paper was read by Mr. Koerting, of Hanover, on gas motors for producing electrical energy. Great advantages were claimed for this system. The gas plant is cheap in first cost, occupies but little space, and utilizes a large proportion of the energy of the fuel. The relative efficiency of steam and gas engines is shown by the following figures:

	Per cent. useful effect		
Horse-power.	Steam engines.	Illuminating gas motors.	Producer gas motors.
10	2.2	9.1	7.3
50	4.6	9 9	10.2
100	6.9	10.9	12.9

Mr Harry Pollitt, Chief Engineer of the Manchester, Sheffield & Lincolnshire Railway, who has recently been in this country inspecting our railways, is credited with the following expression of opinion just prior to his departure for England: "The feature of your railroads is vastness as compared with compactness in ours. The ability of your managers to arrived at certain results by short cuts would not be recognized by our officials, but it is almost necessary when the extent of your systems is taken into consideration. These remarks, however, do not apply to the Pennsylvania and New York Central railroads, which, without wishing to discriminate, I consider far superior to your other roads. I was particularly impressed with the thoroughness and nicety of detail of the Pennsylvania system, and surprised how closely our methods have been copied, and in certain respects improved upon. You have one advantage which, for practical economy, is incalculable. I refer to the superior intelligence of your conductors, engineers and other employees over ours. That is the basis of your arriving at results with celerity and safety, whereas we have to hedge our view of necessities with more red tape. Taking your systems as a whole, they are marvelous examples of energy, ingenuity and administrative ability."

A series of experiments with glass bearings for line shafting recorded in the *Iron Age* by Mr. Geo. D. Rice, go to show that where everything is in good alignment and properly put together, the glass will work well, but pulleys out of balance or shafting out of line will break the bearings. The glass bearings must, in any case, be held in elastic boxes or supports, wood being the best material to interpoce between the glass and the iron hangers. Glass on glass will run without oil and with very little heating; with oil the heating disappears and the friction is low. The author says: "A summary of the tests would seem to indicate that glass bearings are not so reliable in cases of emergency; at the same time glass bearings in ordinary uses and correctly applied require less oiling, develop less friction and are undoubtedly useful in many places, and there yet may be a future for them, regardless of what experiments may bring out for or against them."

The satisfactory subdivision of hulls into water-tight compartments has long been a serious problem for shipowners and shipbuilders. Mr. D. F. Black, whose name is associated with some of the best-class vessels built on the Tyne, has invented an improvement on the present practice which may overcome financial objections to greater precaution, and certainly cannot fail to impress the owners of passenger steamers, which in these days of competition must be safe at almost any cost. The object of the invention is to minimize the risk of a vessel sinking after collision with another at sea, when, as not infrequently happens, the vessel is struck at or near a bulkhead, and the inventor proposes to gain the desired result by branching each bulkhead on both sides instead of carrying them right across the ship, and by that means confining the inflow of water to only one of the two compartments, which under the existing arrangement would be involved. On the basis of a cargo vessel of 5,000 tons dead weight, Mr. Black calculates that only 9 per cent. of the total hold storage is cut off in the branching, and that even that need not be lost, as provision could be made for the utilization of the spaces. The increased weight is only ¼ per cent. of the total dead weight. In accommodation for passengers on passenger vessels purely there would be, of course, a certain sacrifice, but the greater safety would in the long run be an important set-off.—*The Steamship.*

On December 5, the United States gunboats *Vicksburg* and *Newport* were launched at the Bath Iron Works, Bath, Me. These boats are of composite construction, having steel frames throughout, over which is planking covered with copper. The advantage over a steel skin is the comparative freedom from accumulations which require steel ships to be docked frequently to have their bottoms scraped. The boats are 200 feet long over all, 36 feet beam, 12 feet draft, and of 9,000 tons displacement. The engines are three cylinder triple expansion, of 800 horse-power, and the speed is 12 knots. The coal capacity is 300 tons. The sail area is 11,500 square feet. The armament consists of six 4-inch guns, four 6-pounders, and two 1-pounders, all rapid-fire guns.

The old-fashioned four-wheeled coal cars known as "jimmies," holding about six tons each, are gradually going out of use on the Lehigh Valley Railroad, and are being superseded by the large eight-wheel cars, which carry 60,000 pounds. The former are liable to jump the track, and trains composed of them frequently break in two when starting or crossing a "summit," or "buckle up" when stopping suddenly or backing on a curve. For this reason the company has decided to retire them from service as fast as they wear out or are damaged by accident, in case the cost of repairs necessary to put them in running order shall exceed the sum of $14. In order to ascertain this cost the damaged cars are examined by an expert car-builder, and upon his verdict the cars are either sent to the shop for repairs or are "broken up" for firewood. Properly speaking they are not broken up, but are taken apart, piece by piece, and the wood is sawed up for use under locomotive boilers, while the wheels and other iron-work are relegated to the scrap-pile. One man can usually break up two cars a day, receiving one dollar a car for the work.—*New York Evening Post.*

In an article on high buildings in New York City the *Scientific American* thus describes the most notable building under construction in the city, and for which ground has been broken on Park Row, opposite the Post-Office; "It will cover an area of nearly 15,000 square feet, and in no part will it be less than 25 stories in height. The front facing the Post-Office building will be 27 stories in height, the top cornice being 336 feet above the street level. The two flanking towers will each contain two stories to be used as offices, the cornice of the towers being 355 feet above the street and the top of the lantern 386 feet above the same level. The foundations will extend 34 feet below street level, making the total height of the structure from top of piles to top of lantern, 420 feet. The foundation will consist of piling capped with 10 inches of granite bedded in cement. Upon this will be 4 feet 9 inches of brickwork, stepped up to a granite capping. Upon this will be placed a grillage of steel I-beams and a series of huge box girders, some of them 8 feet deep, for distributing the pressure of the columns evenly to the brickwork. The largest of these girders weighs 55 tons. The approximate weight of steel in the building will be 9,000 tons; the total dead and live load will be about 50,000 tons, distributed upon some 4,000 piles.

The most recent and most important step thus far taken in the United States in the application of the storage battery to electric-railway work, says the *Electrical Engineer*, is embodied in the installation just completed by the Electric Storage Battery Company for the Union Traction Company of Philadelphia. The plant under consideration is situated at the end of a feeder, 11 miles long. This year it was decided to extend the line several miles, and it was found that it would be necessary either to build a new power-house or install a battery sub-station, as the required addition to the existing feeder system would necessitate such an enormous outlay for copper as to render it commercially impossible. The cost of copper alone, to carry out this extension and double the service on the section, would be four or five times the total cost of a battery installation to fully meet all the requirements; and a new power-house was out of the question on account of the heavy operating expenses. Before the extension was made the pressure at the end of the feeder was barely enough to operate cars on schedule time, and the pressure varied as much as 50 per cent. Under the new arrangement, the load on the section varies from 100 to 700 amperes; the feeder carries a constant load of 400 amperes, the battery discharging or charging to the extent necessary to maintain this condition. The result in actual practice is found to be that the feeder load remains constant at this average current and is absolutely independent of of the fluctuating demand on the line. The battery-house contains 248 cells. Each cell contains 13 plates, type "G," chloride accumulator. The maximum discharge rate of the battery is 400 horse-power for one hour. The plates are contained in lead-lined boxes, mounted on two tiers of oil insulators. The connections are all made by continuous weld, no mechanical contacts being used throughout the battery.

The Royal Blue trains on the B. & O. Railroad made some remarkable runs in November. Probably the best performance of the month was on Nov. 15. Train 507 (the Chicago limited), with engine 1308, hauling 11 cars, the entire train with the exception of three cars being vestibuled, left Camden Station, Baltimore, at 7:04 p. m. and arrived in Washington at 7:52 p. m., being a run of 40 miles in 48 minutes. This train covered the distance between Muirkirk and Alexandria Junction, on the Washington Branch, 8.1 miles, in seven minutes. This was an exceptionally good run, when it is taken into consideration that the speed had to be slow through the cities of Baltimore and Washington, and there was one slow order on account of sewer construction.

In the January number of *Harper's* a paper entitled "Science at the Beginning of the Century," by Dr. Henry Smith Williams, will be an important contribution to the history of nineteenth-century civilization and will be followed by other papers showing the progress of scientific discovery during the last hundred years. These papers will be fully illustrated.

CONSTRUCTION AND MAINTENANCE OF RAILWAY CAR EQUIPMENT.—IX.

BY OSCAR ANTZ.

(*Continued from page 339, Vol. LXXV.*)

BRAKEBEAMS.

On account of the great pressure exerted by the air-brakes, brakebeams must be made strong and stiff and wooden beams have been almost discarded by many roads. Nevertheless, a wooden beam of ample proportions, well trussed and of good material has considerable merit, is cheaper and easier to repair than a metal beam and is therefore still used by some roads. Such a beam is shown in Figure 57. *A* is the wooden beam trussed by a one-inch rod *B*, passing at the ends through washers *CC* and at the center over the malleable iron fulcrum *DD*, through which the truck lever passes and is attached by means of a pin. This fulcrum as well as the brakeheads *EE* are fastened to the beam by means of bolts.

Metal brakebeams in large variety are in use and are giving more or less satisfaction. Almost every shape of iron and steel has been tried, such as rectangular bars, angle and T bars, pipes and various shapes of pressed steel, the general shapes of the beams being similar to that of the wooden one, consisting of a main member and a truss rod. We illustrate only one of these beams and it is shown in Fig. 58. The main member consists of a piece of 2-inch iron pipe, *A*, slightly cambered at the center to the ends of which are fitted the brakeheads *BB*, which also serve as washers for the nuts of truss-rod *C*, which is of 1-inch round iron. A nut-lock placed under the nut prevent this truss from working off. The safety hangers are fastened to the clips *DD*. The brake lever fulcrum *E*, as well as the other castings on the beam, are made of malleable iron.

Brakebeams are hung either between the two pairs of wheels or on the outside, the height from the rail being about 13 inches, no part of the rigging being allowed to come less than $2_{\frac{1}{2}}$ inches from the rail. When inside hung, the beams are suspended from some part of the truck; when outside hung, from the body of the car. To make the brakes as effective as possible, the distance between shoes and wheels should always be maintained at a certain figure, about $\frac{3}{8}$ inch being considered good practice, in order to get an average piston travel. This, of course, cannot be entirely accomplished in practice, but the manner of suspending the brakebeams can materially aid toward this end. When suspended from the carbody or truck bolster, the brakebeams will be lower when car is loaded and springs are compressed than when car is light, and the conditions are therefore not the same. If the brakeshoes are adjusted when the car is light, which is the general practice, they will be too far away from the wheels when car is loaded, and if adjusted under a load, they would probably be too close when the car is light, and cause the wheels to slide. It is therefore preferable to suspend the brakes from a part of the truck which bears a fixed relation to the wheels, and this is found in the spring plank or transom when the latter is used.

Fig. 57 shows the usual manner of suspending outside hung brakebeams. The brakeheads *EE* have holes cast in their upper ends, through which is passed the hook on the end of the brakebeam hangers *FF*, which are made of 1-inch round iron; the upper ends of these hangers are bent in the form of an eye around another eye on the end of a plate *GG*, which is fastened to some part of the floor frame of the car by two bolts, and also has a hook turned on its top to further secure it. To prevent the brakebeam from falling on the track should a hanger break,

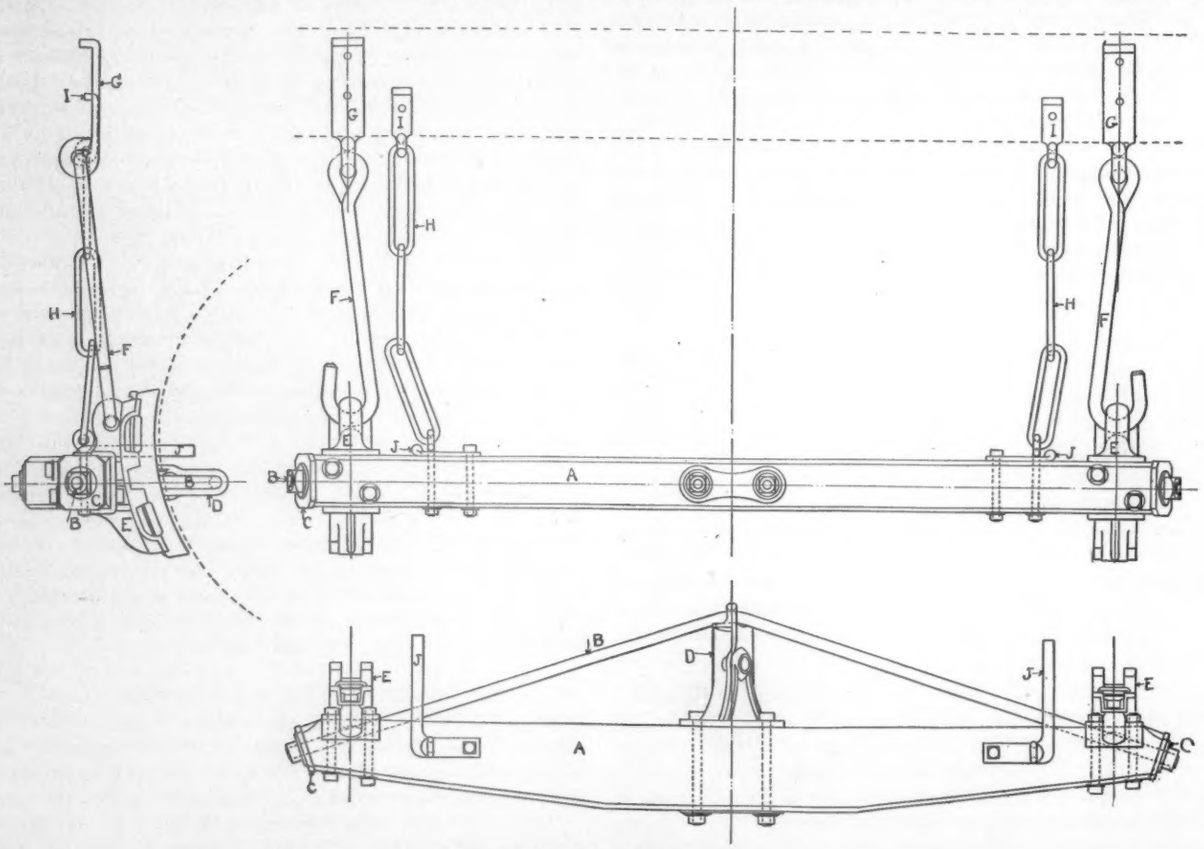


Fig. 57.—Wooden Brakebeam.

safety hangers are provided, which are usually made of three links of about $\frac{1}{4}$-inch round iron, *HH*, secured at the upper end to a hook plate *II*, and at the lower end fastened to the brakebeam by an eyebolt passing through the beam, or, in the case of metal beams, by some clip or other attachment. Safety chains should be hung so that there is a little slack in the links, to prevent wear on them, so that they will be in good condition should occasion require their use.

With outside-hung beams it is necessary to provide some kind of guide to keep the brakeshoes on the wheels laterally, and this is usually made of pieces of one inch round iron *JJ* fastened to the

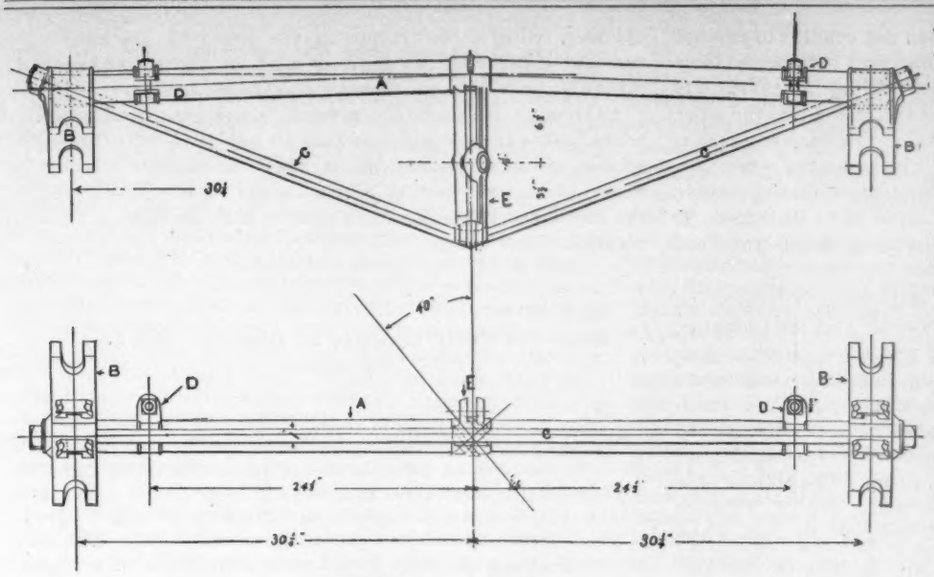


Fig. 58—Iron Brakebeam.

beam at points where they will come close to the inside flanges of the wheels.

Fig. 59 shows a method of suspending inside-hung iron brake-beams. On account of the short distance available the point of suspension on the beam is at the center instead of the top of the brakehead. The hangers *FF* are made of ⅞-inch round iron, bent

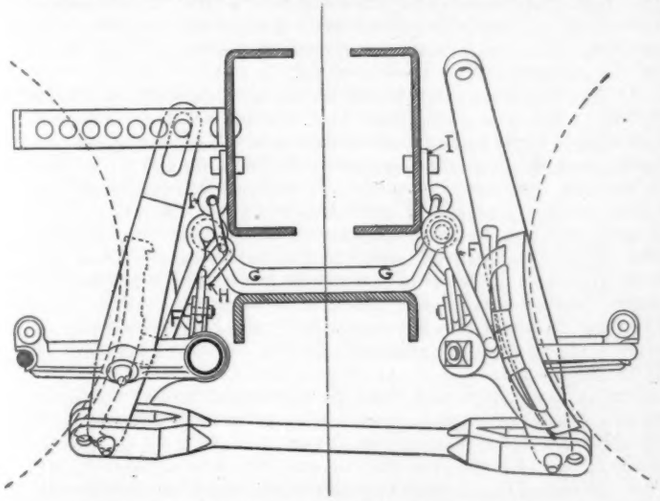


Fig. 59.—Inside Method of Hanging Brakebeams.

in the shape of a U, the upper ends being turned into eyes through which is passed a pin, which secures the hanger to the bracket *GG*. This bracket is of malleable iron and is secured to the spring plank by a number of bolts. The safety chains *HH* are made of three links of five-eighths round iron and suspended from eye-bolts *II*, secured to the truck bolster. Care must be taken that these chains have slack enough so that there will be no strain on them when the bolster is at its highest point. This figure also shows another method of securing the dead lever fulcrum, the slot in the dead lever allowing for its adjustment in different positions.

A standard shape and size has been adopted by the M. C. B. Association for brakeshoes, and this is very generally adhered to. The metal of which brakeshoes are made varies with different roads, and the best metal for the purpose is still a matter of discussion, although many tests have been made to determine this disputed point. Cast iron is no doubt the cheapest; but also the metal which wears out the soonest. Some other metals, while having better wearing qualities, have a tendency to wear the tread of the wheel to an alarming extent. Shoes combining several metals, as for instance pieces of ore metal sei tnto the wearing surface of a shoe made of a different ore, seem to come nearer to the conditions required than any other shoe yet produced. Further tests on this subject are looked forward to with great interest.

AIR-BRAKE APPARATUS.

The usual arrangement of the air-brake apparatus on a freight car is shown in Fig. 60. The train pipe *AA* of 1¼-inch pipe runs the full length of the car, the ends being located 13 inches from the center and to the right of it when looking toward the end of the car; the pipe is fastened at convenient points by means of pipe clips and lag screws into the sills of the car. It is not always possible to run the pipe in straight lines as shown, and it has to be made to clear obstructions, lowered or raised perhaps to pass under or through the body bolsters, and when ths is necessary, the pipe should be bent and no elbows or other fittings used. The pipe should be blown out to remove scale and dirt before putting the different pieces together, and the joints should be made with oil or varnish, and no red or white lead should be used, as this is liable to get into the brake apparatus and cause trouble. The ends of the train-pipe are provided with angle-cocks *BB*, which when a train is in service are open on all the cars excepting on the rear end of the last car. The handle of the angle-cock is curved to the general outline of the cock, bringing as it is possible without interfering with its operation, and when open or in running position it stands parallel to the pipe, in order to prevent as much as possible the liability of having the cock closed accidentally when the train is running by rocks or other missiles which might be picked up by the suction of the train. Into the angle-cock is screwed a dipple to which is attached a piece of rubber hose 22 inches long, at the other end of which is a clutch coupling provided with a rubber gasket. To connect two cars together the couplings of the two adjoining hose are interlocked,

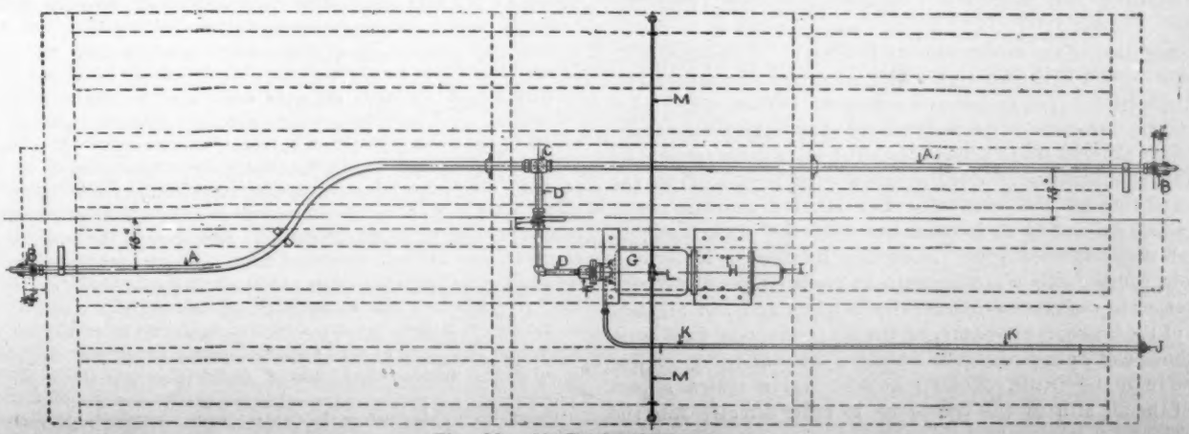


Fig. 60.—Air-Brake Apparatus.

the gaskets making a tight joint. When not coupled to another hose, it was customary, until a short time ago, to hang the loose end of the hose into a so-called dummy coupling, to prevent dirt and dust from getting into the hose and eventually into the other brake apparatus; but it has been found that this caused considerable damage to the hose on account of it being kinked when thus hung up, and, as the joint was not dust-proof, it did not exclude dirt entirely, and recently almost all roads have discarded the dummy coupling, allowing the hose to hang down when not coupled.

Near the center of the car, in the train-pipe, is located the strainer and tee *C*, which connects the cylinder with the trainpipe, the strainer part consisting of a piece of perforated tin which prevents foreign substances from entering the brake apparatus. From the strainer leads the cross-over or branch-pipe *D*, in which is located the cut-out cock *E*, by means of which the air can be cut off from the cylinder of the car without preventing it from passing through the train-pipe to the rear cars. The branch pipe is connected by means of a union to the triple valve *F*, which is of peculiar and delicate construction, allowing air to pass, when in release position, from the train-pipe into the auxiliary reservoir *G*, where it is stored until needed for braking purposes, when by a movement of a valve in the triple, the air is allowed to enter the cylinder *H*, forcing out the pison and piston rod *I*, which operate the push rod and set the brake. When brakes are to be released, a reverse motion of the valve establishes communication again between the train-pipe and reservoir and the air in the cylinder is exhausted into the atmosphere through a port on the side of the triple. Ordinarily it would be sufficient to exhaust directly into the atmosphere at this point, but it has been found that on long grades it is often desirable to retain a small amount of pressure in the cylinder, after the higher pressure used in braking has been released, and for this purpose there is provided the pressu-reretaining valve *JJ*, connected to the triple valve by the ¼-inch pipe *KK*. This valve is weighted so that it will remained closed until the pressure under it exceeds 10 pounds, thus insuring that pressure in the cylinder at all times when the valve is in use. When this pressure is not required on level track, etc., a handle is turned which allows the air to escape directly to the atmosphere. The pressure-retaining valve is usually located near the hand brake, within easy reach of the brakeman when passing from car to car. The pipe is fastened to the car by staples driven into the sills. The cylinder and reservoir are attached to blocks of wood which are secured to the frame of the car by bolts passing through the sills. The piston in the cylinder is made tight by a leather gasket, which is forced out against the cylinder by a steel ring, and is held in place by a follower. When air is released from the cylinder after having been applied, the piston is forced back to the end of the cylinder by a steel spring surrounding the piston rod. The reservoir is provided on its top with a release valve *L*, which can be operated from either side of the car by means of handles *MM*. It is necessary sometimes to release the brakes by this means, when for some reason there is not sufficient pressure on the locomotive to overcome the pressure in the reservoir and cylinder. In the bottom of the reservoir is placed a plug to drain out condensed moisture.

The operation of the air-brake is as follows: A pressure of 70 pounds is carried in the train-pipe and auxiliary reservoir when the train is running, or brakes are released. When the brakes are to be applied some of the pressure is exhausted from the train-pipe which causes a movement of the slide valve in the triple, and allows air to enter the cylinder through a pipe passing from the triple, and through the reservoir. For making ordinary stops, only a small amount of air is exhausted from the train pipe, and the triple does not make a full connection between cylinder and reservoir, causing only a low pressure in brake cylinder. When, however, as in the case of emergencies, a quick and full application of the brakes is necessary, all the air possible is exhausted from the end of train-pipe, which causes a greater travel of the slide valve in the triple, opening another valve which allows some of the air still in the train-pipe to enter directly into the cylinder, reducing the pressure in the pipe very quickly to the rear end of the train and utilizing some of the air which would otherwise have to be exhausted to the atmosphere.

As pressure is constantly carried in the pipes and reservoir when brakes are released, a failure of any part under pressure, such as the bursting of a hose, or when the hose is uncoupled by reason of the train parting, will allow the air to escape and apply the brakes and the train cannot proceed until the damage has been repaired.

(To be Continued.)

Shall the Cubic Capacity of Ordinary Box Cars be Increased?*

BY H. H. PERKINS.

The report of the meeting of the New York Railroad Club, held Feb. 20, contains an exhaustive and very interesting handling of the subject of large cars, and desiring to hear the question of maximum size of cars discussed, and thinking it might interest others, the attention of the committee was called to it; and they, instead of giving me bread, gave me a stone in shape of a request to prepare a paper on the matter to read at this meeting. Like the little boy, who presented himself before his mother with clothes soaking wet, when asked how they came so, replied that a boy dared him to jump into the river, where it was over his head, and he wasn't to be dared—neither was I.

Many of the members may have read the New York report, and it would be presumptive in me to expect to add anything thereto. It was with the expectation of hearing from others that the subject was mentioned; and, claiming no scientific or mechanical knowledge to impart, I can only relate the personal experience and reminiscences of a freight man, for which please bear with me for the few moments you will be detained.

My first recollection of freight cars is a four-wheel car on the Boston & Maine; but, as a good place to fish or a half-holiday from school had more interest for me in those days than the dimensions of cars, I can only estimate them at about 20 feet long and 7 feet wide. When first employed—a boy—in a freight office, I can recall that 7 tons were considered a carload. When old enough to tally freight into cars, the dimensions were 28 feet long, 7 feet 9 inches wide, and 8 tons a carload; when 10 or 12 tons were put in by accident or design, although the fear was often expressed that they might break down, no one appeared to worry over a little thing like that. Later, these same cars were rated as 10-ton, and the same size, with probably larger journals, were branded capacity 24,000 pounds.

During these years and changes, the forests in the immediate neighborhood of the tracks were being consumed by fires under the locomotive boiler and elsewhere, or buried under the ground in the shape of ties. Lumber was cut in saw-mills with a single upright saw, and carted in the rough to where it was to be used, there dressed by hand as needed. Soon wood and lumber, disappearing from alongside railways, had to be obtained from distant points. Transportation, at first too expensive by rail, followed the water routes; but improved mills and machinery, growing towns and cheaper rail rates created a demand for manufactured lumber. It began to be shipped in the 28-foot cars, which being hardly long enough for two fourteens, a demand for longer cars for lumber resulted in the 30 and 34-foot car, the latter about 8 feet wide and 6 feet in the clear becoming the standard—allowing two 16's to 1. The old 28-foot car began to be despised by shippers, until it is difficult to induce them to load such, even with sand or pig iron—they feeling they are not treated fairly when shown a small car to load, it being much easier to stow a load in a large car, even when the bulk does not require it.

Furniture and carriages, which had been manufactured at small shops in the neighborhood, where used, began to be made some distance away, nearer the lumber supply, as it was cheaper to transport the finished product than the rough lumber, including refuse and waste; and as the classification, on which freight charges were based, favored large cars, a demand was created for even a larger car than the 34-foot, manufacturers holding out inducements to roads to build them for these particular freights. About the time the furniture cars first made their appearance, at a meeting of the employees of a certain road, a freight agent reported to the superintendent that a rival road had built some furniture cars, and he could get no more of that class of freight; but, if the road would

*From a paper read before the Central Railroad Club in November, 1896

only build a few such cars, he told how much business he could secure. The reply of the superintendent contained considerable truth when he said: "If this road should build furniture cars, the other road would only wait until they could take their measure to build larger"—a prediction that was fulfilled, and both roads have since furnished just as large furniture cars as will run under the bridges and through the tunnels.

Shippers like to get big cars, even when the freight does not actually require it, but the demand for these excessively large cars was undoubtedly influenced and over-estimated by soliciting freight agents, who, under implied promises from shippers, represented to the authorities that a supply of large cars would add materially to the earning capacity of the roads, more than facts warranted. My own doubts were raised on this subject, when I could see standing at a certain carriage factory from one to five of these large cars, belonging to two or three different roads, sent there by orders of the soliciting freight agents, and kept standing there for weeks or months, if necessary, to be there in case if the carriage factory received an order, it would not ship via the other road for want of a big car. If it is necessary to keep cars standing like that for loads, it certainly does not pay to build them to carry freight at ordinary rates. Probably, the soliciting freight agent reported securing a carload from the other fellow, carefully omitting to mention the expense, estimating a car idle as a certain amount per day. Car service rules have done away with this abuse to a certain extent.

Furniture and carriages were the first to cause the 34-foot to grow from 6 to 8 feet high inside; but the fact these cars could be obtained stimulated the manufacture of baskets, barrels and boxes, where the supply of lumber was cheapest to be transported where used. These light goods demanded even larger cars; and the 40-foot is now frequently seen, and even a few 60-foot freight cars have been hauled over the roads. Hay, first carried in ordinary cars, now demands the largest from the prairies of the West to the towns and cities of the East. How long will shippers of these light commodities be satisfied with the present size of even furniture cars? Will not the soliciting agent represent that the demands of shippers require 45 or 50-foot cars, 8-foot high, 9-foot wide, with a capacity of 1,500 or 2,000 bushels of grain, instead of 1,000 as now, and 500 as formerly?

Some little time ago a shipper came to me representing he was in a great hurry to load a car of lumber, and, as usual, requesting a large car, "right away, quick." There happened to be a furniture car over the home road of which the lumber was to go; and, in order to send it home, it was placed on track for him to load. Not a piece of lumber was put in the car for two days; and, having use for a furniture car to same destination, it was taken away and a standard car substituted; and the change was hardly made before that same shipper was in the office demanding the return of the big car, as he had been two days getting out extra lumber in order to fill it. This instance is related to show that the demand for large cars is only created by a supply and, once furnished, becomes the expected. The tendency is to fill cars, whatever the size, as the larger the car the greater the sale; and the carload being the standard for minimum freight rates, if the customer is good, the shipper would fill a barn as a carload, if possible. I once knew of a man, selling a carload of brick, who filled one of the old 10-ton cars with brick to the roof; it never moved until it was entirely unloaded and then—to the shop. It must be admitted that the shipper benefits in larger sales at one time; but would not the same amount be, eventually, hauled in two cars, were there none of the excessively large cars? and, perhaps, the railroad may benefit a little from concentration of weight on eight wheels; but, when there is extra haulage and switching necessary to get special cars to certain tracks, where standard cars may may be standing, it is doubtful if these cars add very much to the earnings of a road.

Years ago, in conversation with a then division superintendent, afterward a railroad manager of distinction, I remarked we would see cars carrying a thousand bushels of grain from Chicago to New York; he replied: "Never, as the tendency would be to reduce the size of loads rather than to increase them." We have both seen more than was predicted.

The country is growing, and business is not only keen among manufacturers, but also between railroads; and, unless the railroads can agree among themselves to limit the size of cars, the 60-foot car is bound to come. It is here for empty barrels, next empty boxes and baskets, carriages, furniture, hay and agricultural implements; if they hold off, one railroad against another will get them, and shortly other commodities will demand them.

The question placed before the committee was, "what will be the maximum size of box freight cars? It is limited now on Eastern roads by the height of their bridges, or size of their tunnels, but on the prairie roads, apparently, by the sky and the horizon. Will it remain 40 feet long, 15 feet from top of rail, 10 feet wide, 30-ton capacity, which is now about the practical maximum; or will it, in a few years, evolve to 60 feet long, 20 ft. high and more than 10 feet wide?

Some may claim these latter figures are impossible, but they are no greater than the present maximum appeared when railroads were first projected; and, although size of tunnels and height of bridges limit the maximum now, is there any limit to which changes in these can be made? Is the maximum always to be limited by the present tunnels and bridges, or will the Eastern roads have to increase the size of tunnels and bridges in order to haul what the Western roads can furnish patrons? It strikes me that the question whether large cars pay the roads has never been fairly considered; the subject only being looked at, as what has the other fellow done; what he has done, we can do; therefore, if one road builds cars 60 feet long, 50 ton capacity, straightway another follows suit, even if bridges and tunnels have to be enlarged to do it. There is no limit to what a roadbed can be made to bear. Is not the 50-ton car a probability, and the 100-ton car a possibility? Would it not be better for the associate roads to agree on a maximum size and refuse to handle or haul beyond that limit, and the plant of railroads can gradually be made to conform to that standard?

Apparently, the concensus of opinion, among those quoted by the New York committee, is that the standard of length will have to be increased to 40 feet, and if this is agreed to by the associate roads, the quicker some agreement is entered into by all roads not to receive or haul longer cars the better; otherwise, the 50 or 60-foot car will be tendered them inside of a year after the 40-foot car is accepted as the standard; and, thereafter, it will occupy the position of the 40-foot at present.

There was to have been a meeting of the New York committee, Oct. 6, in regard to limiting size of freight box cars, but I have seen, as yet, no report of their conclusions, though, undoubtedly, it will recommend the increase of the present standard to 40 feet in length. But will that be the limit? Is not the 60-foot 100-ton car in process of evolution?

The Progress in the Manufacture of Iron and Steel in America and the Relations of the Engineer to It.*

BY JOHN FRITZ, BETHLEHEM, PA.

Having frequently been asked by members of the American Society of Mechanical Engineers, and others, to write a paper on the manufacture of iron and steel in this country, showing its progress since the time of my first connection with it (and quite recently I have not only been asked, but urged to write a paper on this subject from a mechanical and engineering standpoint, giving an outline of the early troubles, and showing the great improvements that have been made in machine tools and machinery, as well as in the manufacture of iron and steel), after some hesitation I have concluded to make an effort to respond to these requests. In complying therewith I shall to some extent quote from a paper read before another society of engineers, and give such additional items of my experience as I have thought would have been interesting.

As a beginning I will make a brief allusion to the mechanical engineer, showing his origin and growth, and what he has accomplished in the great field of metallurgy, and especially in the Bessemer and other important steel-making processes. It seems to me eminently proper that in describing the development of the mechanical engineer his growth should be considered jointly with that of the metallurgist, especially when we take into consideration how essential good iron and steel are to all engineers. In fact, it is the marked improvements in the manufacture of iron and steel that have enabled the engineers to surmount the difficulties and erect works that would have been well nigh impossible before these improvements were made; and to the mechanical engineer is largely due the credit of the marvelous improvements that have been accomplished. And here let me say that but few people know anything of the labor, the troubles, trials, vexations, surprises and disappointments that were encountered during the early stages of that now great industry, the Bessemer process; and, besides, all the physical danger to which they were constantly exposed.

When I look back and review the roll-call of memory, it brings to my mind faces of men who lost their lives while engaged in the performance of their duty; some of them were near and dear to me, being associated by the closest of personal ties. They are no more; but to those who knew them, and what they accomplished, their memery is forever sacred.

Prior to 1838 the manufacture of pig iron was in a primitive condition, that metal being practically all made in charcoal furnaces, producing from fifteen to thirty tons per week, and was converted into wrought iron in the old-fashioned charcoal fires, and was

*President's address presented at the New York meeting (December, 1896) of the American Society of Mechanical Engineers.

shaped into blooms for the rolling-mill, and into bars for the smith by a helve hammer. The furnaces, forges, and mills were all driven by water power. and were kept in order by what was sometimes called a forge carpenter. or millwright. At this time the mills were all geared, the shafts being square, hexagon or octagon, according to the fancy of the millwright; the wheels were secured on the square shafts by wooden blocks, and in them were driven thin iron wedges; the segments of the wheels were secured to the center in the same manner; the roll housings were all set on wood. All this crude machinery the millwright was called on to keep in running order; consequently he became an important man.

In 1840 the use of anthracite coal and coke in blast furnaces was commenced. This required a much higher pressure of blast. Previous to this time the blowing cylinder had been made out of wood, the pressure of blast being very low, not exceeding one and a half pounds; hence a great improvement in blowing machinery became necessary.

In 1842 puddling began to come into more general use, and puddling trains had to be built, and better merchant or bar trains were now required; they were all geared, and gave much trouble. The machinist now had to be called in to help keep things in shape, and he soon took the millwright's place, and laid the foundation for the mechanical and metallurgical engineer.

In 1845 the rail mills were being built, and stronger and better workmanship was required. These mills were all geared, but the shafts were generally turned up, and wheels all bored out, and fitted up in a much better manner, which required more skill and better workmen. Puddling now became an important branch of the iron business, and the "Old Harry" was generally to pay to get the balls in proper shape; to do this mills were using the old Welsh hammer. Numbers of squeezers were tried and failed; finally the Burden squeezer was invented and adopted by the mills generally, and to this day is the best machine that has ever been devised for the purpose.

In or about the year 1848 "boiling" came into use, which was a great improvement over ordinary "puddling," and gave a new impetus to the trade. From 1848 to 1856 there was no great change or marked improvements made in the business. In 1857 the three-high rail mill was successfully introduced and in a short time practically revolutionized the manner of rolling rails. From this time on all the new mills that were built were driven direct, without gearing, and much stronger and better in every way. It was during this time that the great changes and improvements were being made in rolling-mill and blast-furnace machinery and also in machine-shop tools of all kinds, which enabled much better work to be turned out than had been previously possible; and this was an advance for the mechanical engineer, and prepared him for the great work that he was soon to be called on to accomplish.

In 1864 the Bessemer process was introduced, and it soon became evident that it would in a short time revolutionize the iron business. Its introduction and perfection will ever remain one of the most interesting and important epochs in the whole history of the iron business. It was now that the men that had been in training were called to the front, and nobly did they do their duty. This was the graduating period for them, and no set of men ever worked more faithfully or earned their diplomas more honestly than these men did. Their diplomas were not made of parchment, but of bright ideas, hard work, and energy, coupled with a determination that made failure impossible.

Sir Lothian Bell, in an address before the Iron and Steel Institute in 1896, said: "In viewing the impressive but simple process of blowing a charge of metal it is difficult to realize the disappointments and the large expenditure of money and indefatigable energy required before its present condition was reached." I will go further and say that I do not believe it possible to describe the feelings of fear and anxiety that existed in the minds of those who had the immediate charge and were responsible for the result.

It is not the object, nor is it possible in a paper like this, to give a description of the process, or to even faintly describe the difficulties that were encountered in its incipient stages, but I feel as if I should do violence to my feelings were I to fail on this occasion to make some allusion to those brave and noble men who fought these early battles to a triumphant conclusion; and, as the Hon. Abram S. Hewitt has truly said, "The Bessemer invention takes its rank with the great events which have changed the face of society since the time of the middle ages"; nor am I unmindful of the assistance rendered by the brave and noble workmen who so ably supported their chiefs and who were ever ready and willing to face any danger or difficulty that might occur.

Having already stated that the Bessemer process was introduced in 1864, of course but little steel was made in that year. I do not propose to give you a yearly array of statistics, but in 1895 the production reached the enormous quantity of 4,909,128 tons of ingots. In the same year the production was of puddled iron 1,500,000 tons, making a total of steel and puddled iron 6,409,128 tons.

In order to show what the Bessemer process can do in coal and labor, as compared with puddling, the former can produce in 10 minutes 10 tons of steel ingots, with a consumption of twenty hundred of coal. It will require a puddling furnace 10 days, with practically three men, to produce a like amount of puddled iron, and will require about 20 tons of coal. The puddling is a hard, laborious and exhausting occupation. With the Bessemer it is care and attention only, but that it must have.

We left the blast furnaces in 1840, making fifteen to thirty tons per week, and produced in that year 286,903 gross tons. In 1895 we have furnaces producing between two and three thousand tons per week, and others building that are expected to make much more. The total output in 1895 was 9,446,308 gross tons, which exceeds the quantity made by any other nation.

It was the marvelous increase in the production of iron and steel which took place after the year 1865 that gave such a remarkable impetus to the engineering trades. The demand for Bessemer pig iron caused new blast furnaces to be built of much larger size than formerly. The blowing engines were required to be of much greater capacity and more powerful. The material used in the construction of these furnaces stimulated other branches of business, in many instances beyond their capacity. When the Bessemer process came into use blooming mills had to be built, new rail mills, billet mills, and plate mills; in fact the introduction of Bessemer rendered the old iron rolling machinery practically useless; consequently new, heavier, and more powerful mills had to be erected.

The rail mills, with one exception, are three-high, and fitted up with tables arranged for automatically handling the work, and they are equipped with every facility that will quicken and cheapen the handling of the material. In 1866 the Siemens open-hearth furnace for making steel was introduced, but it was some time before it came into general use; the Bessemer for quite a while held it in check. To day it occupies an important position, and, in connection with the Thomas basic process, one of the great metallurgical inventions of the age, is sure to become a strong competitor of the Bessemer process. When I allude to the Siemens open-hearth furnace I do not mean that their form of hearth and ports should be strictly adhered to, as there are other styles of furnaces which have their advocates; among them are the partial revolving hearth, which so far has shown good results, and it certainly has advantages over the fixed hearth. What I refer to is the Siemens regenerative principle, which is truly scientific and yet perfectly simple in its construction, and so far is the only method by which the metallurgist has been able to secure the heat necessary for making steel on the open-hearth plan; and all steel-melting furnaces, of whatever form the hearth has been constructed, use the Siemens regenerative principle. Much as I admire the Bessemer process and well know what can be accomplished with it, yet if the users of steel insist on lower phosphorus, it will have to be made in the open hearth, and by the Thomas basic process, as the ores that will make steel of high grade by either of the acid processes are, so far as known, quite limited; and the Thomas basic Bessemer requires high phosphorus, as the pig iron should have at least two per cent., and this is more difficult to obtain in quantity than the low is for the acid processes. Steel can be made in the open hearth, on acid lining, quite low in phosphorus, but at a greater cost, as you must start with first-class material, while the basic might be called a kind of scavenger. I do not say this in a disparaging sense, but, on the contrary, a material that is perfectly useless (so far) in either of the acid processes. can be utilized, and a fairly good steel can be made out of it, by the basic process, and it is this quality which makes it such an important improvement in the science of metallurgy. It is, however, like all other processes; if you want to make a good article you must have the proper material to start with. Now, while it is being rapidly introduced in many parts of the country, I think it proper to say that there are large users of steel of high quality that will only use the acid open hearth.

There are several other forms of steel-making furnaces, among which are the Pernot and the Ponsard; both of them were designed for more rapid working. The former has an inclined rotating hearth, which keeps the metal in motion, and is supposed to work more rapidly than the fixed or stationary hearth. The latter (Ponsard) is in its construction very similar to the Pernot, it being designed to work more rapidly than the Pernot, and introduces blast same as Bessemer, thereby combining the two processes by blowing the metal partially, and then finishing it by the Siemens process. Both systems use the Siemens regenerative principle.

I have now mentioned the several processes for making steel rapidly, but to describe them fully would not only be impossible, but out of place in a paper of this kind, as it would require a large volume to give an intelligent description of them all; but I hope I have succeeded in giving you such an outline of the various processes as will enable you to form some general idea of them, and the results obtained, and shall again refer to them in speaking of the finished product.

Having given you a very brief account of the progress of the iron and steel industry from its infancy up to the enormous production in 1895, I shall now endeavor to show the wonderful changes that have been made in machine tools and shop practice.

(To be continued.)

On November 15 the electrict current was turned on for the first time between Niagara Falls and Buffalo. The line is 26 miles long and the horse-power at present transmitted is 1,000, and is for the operation of street cars. The Power Company is, of course, prepared to furnish as much power as the demand for it arises. The interest in this case of power transmission is great. for the Power Company must compete with steam power, generated in a community where both coal and labor are cheap. There is no question about the ability of the company to successfully operate a long-distance transmission, but the interesting problem is what the power will cost in Buffalo. In discussing this phase of it *Electricity* gives the following adverse opinion: "In the Frankfort-Lauffen experiment, it will be remembered that the transmission of 300 horse-power was effected with an efficiency of 75 per cent., but cost five times as much when delivered as it could be generated for locally. In Fresno, Cal., where 1,400 horse-power is transmitted 35 miles by the three-phase system, and at San Bernardino, where 800 horse-power is transmitted 28 miles by the single-phase system, the delivered power is competing with power generated locally from coal costing $13 per ton. At Buffalo, however, coal costs but $1.80 per ton and labor is cheap. The commercial problems presented at Buffalo and in the far West are therefore entirely dissimilar, and it is our deliberate opinion that the Buffalo transmission cannot be a commercial success."

Personals.

Mr. John H. Drake, President of the Charleston, Clendennin & Sutton Railroad, died Oct. 21.

Mr. Peter Smith, Master Car Builder of the New York Central, at Rochester, N. Y., died at his home, Nov. 18.

Mr. Henry Terrell, Receiver of the San Antonio & Gulf Shore, has been appointed General Manager of that road.

Mr. S. M. Dolan has been appointed Master Mechanic of the Wiggins Ferry Company, with headquarters at St. Louis.

Mr. W. A. Bradford, Jr., has been appointed General Manager of the Hutchinson & Southern, with office at Hutchinson, Kan.

Mr. J. J. Thomas, Jr., has been appointed Master Mechanic of the Mobile & Birmingham Railroad, with headquarters at Mobile, Ala.

Mr. C. R. Peddle, Purchasing Agent of the Vandalia Line, has removed his headquarters from St. Louis, Mo., to Indianapolis, Ind.

Mr. R. H. Johnson has been appointed Master Mechanic of the Atlanta & West Point Railroad, with headquarters at Montgomery, Ala.

Mr. G. W. Russell has been appointed Master Mechanic of the New York, Philadelphia & Norfolk Railroad, with headquarters at Cape Charles, Va.

Mr. Charles P. Clark, President of the New York, New Haven & Hartford road, has been elected President of the Fall River Line, vice J. R. Kendrick, deceased.

Mr. W. C. Dotterer has been appointed General Manager of the New Orleans & Western, with headquarters at New Orleans, La., vice Mr. John M. Turner, resigned.

Mr. Wm. J. Fransioli, who has been acting General Manager of the Manhattan Elevated since the death of the late Colonel Hain, has been made General Manager.

Mr. George F. Peabody has been elected First Vice-President and Mr. E. M. Shepard Second Vice-President, of the Mexican Northern, with offices in New York City.

Mr. L. J. Buckley has resigned as Purchasing Agent of the Baltimore & Ohio, and has been succeeded by Mr. E. H. Bankard, who was Chief Clerk to Receiver Murray.

It is announced that the office of Chief Engineer of the Norfolk & Western has been abolished. Mr. W. W. Coe, who occupied the position, it is stated, will retain his connection with the road.

Mr. Frank Barr, Superintendent of the Worcester, Nashua & Portland division of the Boston & Maine, has been appointed Assistant General Manager of the road, to succeed Mr. George H. Evans, resigned.

Mr. Robert T. Baker has been appointed General Superintendent of the Morristown & Cumberland Gap, with office at Morristown, Tenn. He takes the place of Mr. H. M. Aiken, whose title was General Manager.

Mr. C. H. Coit has been chosen Vice-President of the Wheeling Bridge & Terminal Railway, with office at Hartford, Conn. Mr. H. W. Hayden has been chosen Secretary and Treasurer, with office in New York.

The office of General Superintendent of the Vandalia Line has been abolished, and it is stated that Mr. H. I. Miller will probably return to the Pennsylvania lines west of Pittsburgh as Assistant General Superintendent.

Mr. Charles E. Henderson has been chosen Second Vice-President of the reorganized Philadelphia & Reading Railway, in charge of freight traffic. Mr. Henderson will retain the general managership of the Philadelphia & Reading Coal and Iron Company.

Mr. G. M. Dodge has been elected President of the Fort Worth & Denver City Railway, with office in New York City. Mr. K. M. Van Zandt has been chosen First Vice-President, and Mr. Morgan Jones, Manager of the same road, with offices at Fort Worth, Tex.

Mr. J. D. Hawks, Vice-President and General Manager of the Detroit & Mackinac, has been chosen President of that road, to succeed Mr. C. H. Coster, and will retain his position as General Manager. Mr. George M. Crocker, Auditor and Purchasing Agent, has been chosen Vice-President in addition to his former duties.

Mr. Frank M. Baker, General Superintendent of the Addison & Pennsylvania, has been appointed a member of the New York Railroad Commission, to succeed Michael Rickard, deceased. Mr. Baker has been General Superintendent of the Addison & Pennsylvania since Nov. 1, 1882, and was before that date for ten years Station Agent on the Southern Central.

E. R. Reynolds, General Manager of the Long Island Railroad, has resigned. George C. Hubbell, the General Purchasing Agent of the road, has also resigned. The office of General Manager will now be abolished, and the duties will be assumed by the President. Mr. Reynolds has been in the employ of the company since 1879. He is a director and has had entire charge of the road's affairs since the death of Mr. Corbin.

Mr. Robert E. Marshall, Superintendent of the Altoona division of the Pennsylvania Railroad, committed suicide on Nov. 30, by shooting himself while at the home of his brother in Washington. He has for some time been suffering from nervous troubles due to overwork, and committed the act in a fit of despondency. He was 34 years old and entered the service of the Pennsylvania road in 1881. For five years prior to June, 1895, he was Superintendent of Motive Power of the Philadelphia, Wilmington & Baltimore, and since then occupied the position he held at the time of his death.

Mr. M. L. Hinman, who has been President of the Brooks Locomotive Works for the last four and one-half years, is in such poor health that he has retired from the position. At a recent meeting of the stockholders Mr. F. H. Stevens was elected President in his place. Mr. Stevens has been assistant to the President since 1893. Mr. Hinman has been active in the management of the company since 1869, and will continue as one of its officers. The other officers elected at the same meeting are: Vice-President, Mr. R. J. Gross; Treasurer, Mr. M. L. Hinman; Secretary, Mr. T M. Hequembourg; Superintendent, Mr. David Russel.

Mr. Frank S. Gannon has resigned the position of General Manager of the Staten Island Rapid Transit road and General Superintendent of the New York Division of the Baltimore & Ohio, to accept the appointment of Third Vice-President and General Manager of the Southern Railway, with headquarters at Washington, D. C. Mr. Joshua Smith, General Superintendent of the Trans-Ohio divisions of the Baltimore & Ohio at Chicago, succeeds Mr. F. S. Gannon as General Superintendent of the New York Division of that road, and General Manager of the Staten Island Rapid Transit Railway, with headquarters at New York City.

Mr. J. R. Kendrick, Third Vice-President of the New York, New Haven & Hartford Road, died very suddenly of heart trouble in Boston, Dec. 11. Mr. Kendrick was born in New Hampshire in 1833 and began business life as a clerk on the Central Vermont Road. In 1858 he became General Freight Agent of the Manchester and Lawrence Road, and in 1866 was appointed Superintendent. About 1870 he became General Manager of the New Orleans & Mobile, now a part of the Louisville & Nashville. In this position he made an excellent record for administrative ability, and soon received an offer of the Superintendency of the Old Colony. Since the acceptance of that position he has been connected with that system, being for many years General Manager. When it was consolidated with the New York, New Haven & Hartford Road, he was made Third Vice-President in charge of

the lines east of New London. He was held in high esteem by all his associates and subordinates.

Mr. E. M. Herr, Assistant Superintendent of Motive Power of the Chicago & Northwestern Railroad, has resigned that position to become the Superintendent of Motive Power of the Northern Pacific Railroad. Mr. Herr is a man of great ability and has had a wide experience in railroad service. He began railroad work as an apprentice in the Chicago, Milwaukee & St. Paul Railway shops. Later he became Engineer of Tests on the Chicago, Burlington & Quincy Railroad, then Superintendent of Telegraph, and afterward Division Superintendent. He then returned to the former road as Master Mechanic at Milwaukee. This position he resigned to become Superintendent of the Grant Locomotive Works. Upon the failure of that firm he went to Europe with several important commissions from parties in this country, and later made a second trip to Europe in connection with the project of the Russian Locomotive Works. On his second return home he took the position with the Chicago & Northwestern which he has just resigned. Thoroughness and ability have characterized all of Mr. Herr's work in these various positions and his present appointment is a well-deserved honor.

The many friends of Mr. John Hickey will learn with regret that ill health has caused him to resign the position of Superintendent of motive power of the Northern Pacific Railroad. He has held that position since 1891, prior to which he was in charge on the Milwaukee, Lake Shore & Western. The circumstances which have culminated in Mr. Hickey's resignation are particularly sad. In three years he has lost four children, his youngest son dying about one month ago. Those who know Mr. Hickey personally are aware of the depth of his kindly and affectionate nature, and can in a measure realize how severe these afflictions have been to him. His ability, his honorable, upright character and his justice in all his dealings with his fellow-men command the respect and affection of all who have been brought in contact with him. A touching exhibition of this affection occurred when several years ago he was absent from the president's chair at a convention of the Master Mechanics' Association, because of the death of a son. The telegram of sympathy which the association sent him was despatched with exhibitions of emotion seldom seen in a gathering of that kind. One of the highest officials of the road in speaking of Mr. Hickey's resignation a few days ago said:

"Mr. Hickey's service with the Northern Pacific commenced in April, 1891, and he has won the esteem and appreciation of every officer and employee, by the close and intelligent supervision which he has given to the work in his department, and the even-handed justice with which he has treated all of its employees. The necessity which compels him to retire from the company's service is regretted by every one, and it is hoped that the rest which he needs so much will speedily restore to him his usual strength and activity, and that a new career will open for him, which will confer upon him increased honor and prosperity."

Mr. Hickey bore his bereavement bravely and being urged if at all possible to continue his official service remained at his post, though he knew his health demanded a rest. At length, in justice to himself, he resigned.

David Leonard Barnes.

To his wide circle of friends and to the engineering profession at large the announcement of the death of David Leonard Barnes was a severe shock and created a feeling of personal loss and deep regret that a life in which so much had been accomplished, and which gave promise of so great a future, should be suddenly closed. It was in the nature of a surprise, for while most of his friends knew of his illness, few realized that his life was in danger. Mr. Barnes had been suffering from a malady since last spring, and had come to New York for treatment at a sanitarium, where he died suddenly on Dec. 15.

It is seldom that the death of so young a man has caused such universal regret. Though only 38 years old, few men were better known in engineering circles, and his engaging personal qualities and great abilities had won the admiration and friendship of a host of men. Mr. Barnes was a tremendous worker; it was the wonder of his friends how he found the time to accomplish so much, and this wonder was only increased by a closer acquaintance with him and a better knowledge of his diversified interests and pursuits. In addition to conducting a large consulting engineer's practice, he was on the editorial staff of the *Railroad Gazette*, and he found time to contribute many valuable papers to engineering societies and other technical organizations. He had a wonderfully active and fertile mind, and if his enthusiasm and activity occasionally brought his opinions in clash with those of others, it was seldom other than a most friendly combat.

Mr. Barnes was born at Smithfield, R. I., Aug. 23, 1858. When about 11 years old his father died, and he was thus early in life called upon to exercise judgment and self-reliance. At the age of 15 he engaged in town surveys at Providence, R. I., which work he dropped at the end of three years to take a course of study at Brown University and the Massachusetts Institute of Technology. From 1879 to 1882 he was employed in the machine shops of the Hinckley Locomotive Works and the Rhode Island Locomotive Works. Then he became chief draftsman in the latter concern, but after a year or two he resigned to take a similar position with the Rome Locomotive Works, a new concern at that time. He returned to his old position with the Rhode Island Locomotive Works in 1884 and remained with them for three years, during which time he also did some writing for the *Railway Master Mechanic*, and more or less consulting engineering work. In 1887, he went to Chicago and established a consulting engineer's business. He also at that time accepted a position on the editorial staff of the *Railway Review*, which he resigned in 1889 to take up a similar line of work on the *Railroad Gazette*. Since 1888 his work brought him into great prominence. He was consulting engineer for the New York underground railway, and later he was consulting engineer for the Alley Elevated Railway, in Chicago. Somewhat more than a year ago he was appointed consulting engineer for the Baldwin-Westinghouse companies, and produced the designs of a number of electric locomotives and trucks. These are only a few indications of his remarkable activity. His work covered practically the whole range of rolling stock and power for steam roads, elevated, street and electric railways.

Mr. Barnes was a member of the American Society of Civil Engineers, of the American Society of Mechanical Engineers, of the Institution of Civil Engineers (England), of the Western Society of Engineers, of the American Association for the Advancement of Science, of the American Academy of Political and Social Science and an associate member of the American Railway Master Mechanics' Association and the Master Car Builders' Association, and he was more or less active in the work of most of these societies. His papers and discussions before the railroad clubs are well known to our readers.

Mr. Barnes was married in April, 1896 to Miss Ida S. Irwin, daughter of Col. B. J. D. Irwin, U. S. A. Besides his wife, he leaves his mother, one brother and two sisters.

The Strong locomotive, which attracted so much attention some years ago, has been rebuilt into a four-cylinder compound. The four cylinders are all placed in the same plane, the two 16-inch high-pressure cylinders being inside of the frames, and the two 23-inch low-pressure cylinders being outside in the position ordinarily occupied by the cylinders of a single locomotive. The high-pressure cranks are 90 degrees apart, and the low-pressure cranks are each 180 degrees from their respective high-pressure cranks. The engine is claimed to be perfectly balanced, the low-pressure crossheads and pistons being made of special design to secure lightness. The L. P. piston rods are hollow, 3½ inches outside and 2 inches inside diameter. The pistons are made of two steel plates $\frac{5}{16}$ inch thick, between which is riveted a cast-iron bearing ring. By this construction the low-pressure reciprocating parts are made as light as those of the high pressure cylinders. The boiler, frames, running gear and tender are the same as when the engine was known as the A. G. Darwin. The valve-gear is a modification of the Walshaert. The compound features were designed by Mr. Strong, and the engine was reconstructed by the Balanced Locomotive and Engineering Company, New York.

Ten Wheeled Passenger Locomotive—Lake Shore & Michigan Southern Railway.

G. W Stevens, Supt. Motive Power. Schenectady Locomotive Works, Builders.

Ten-Wheel Passenger Locomotives for the Lake Shore & Michigan Southern Railway Company.

The accompanying photograph and specification illustrate and describe one of a lot of ten ten-wheel passenger locomotives which the Schenectady Locomotive Works have recently constructed for the Lake Shore & Michigan Southern Railway Company, for service on the fast trains between Buffalo and Chicago.

The locomotives were designed by Mr. George W. Stevens, Superintendent of Motive Power of the Lake Shore & Michigan Southern Railway, in consultation with the Schenectady Locomotive Works, and possess many interesting features, inasmuch as the boiler capacity of the engines is in excess of anything that has yet been built for a locomotive of this type with the same amount of weight.

It was required in designing the engines that they should not exceed the total weight of 118,000 pounds, with a limiting weight of 90,000 pounds on driving wheels. In order to supply requisite steam for the cylinders, 18 inches by 24 inches, at a working pressure of 190 pounds, it was necessary to employ a boiler of large dimensions, having a grate of sufficient area to afford economical consumption of fuel.

In order to come within the limit of weight, cast steel and pressed steel were used very largely in the construction of the engines. The driving wheel centers, foot plates, bumper knees, guide yoke knees, spring pockets, brake castings, and other minor details were made of cast steel, while pressed steel was used for the boiler front and door, cylinder and steam chest covers, and dome ring. The crosshead is of cast steel of the four-bar guide type with hollow wings and wrist pin. The crank pins are of Krupp crucible steel and are hollow. Each detail of the engine was worked out carefully with a view of reducing weight to the lowest possible amount consistent with a liberal margin of safety.

The locomotives are equipped with the Smith triple expansion exhaust nozzles which are proving very satisfactory in service on the Lake Shore road. From the specifications we take the following:

Gage	4 feet 8½ inches
Fuel	Bituminous coal
Weight in working order	118,000 pounds
" on drivers	88,000 pounds
Wheel-base, driving	15 feet
" " total	24 feet 9 inches
Cylinders	18 by 24 inches
Kind of piston packing	Dunbar
" " " rod packing	U. S. metallic
Size of steam ports	17 inches by 1⅝ inches
" " exhaust "	17 inches by 3 inches
Kind of slide valves	Allen-Richardson balanced
Greatest travel of slide valves	5¾ inches
Outside lap " "	1 inch
Inside " " "	⅛ inch
Valves in full gear	⅛ inch lap in full gear forward, ⅜ inch lap in full gear back motion
Kind of valve stem packing	U. S. metallic
Diameter of driving wheels outside of tire	68 inches
Material " " " centers	Cast steel
Driving box material	Steeled cast iron
Diameter and length of driving journals	Front and back 7½ by 9 inches; main 8½ inches diameter by 9 inches
Diameter and length of main crank pin journals	4¾ inches in diameter by 6 inches
Diameter and length of engine truck journals	5 inches in diameter by 10 inches
Kind of engine truck	4-wheel, swing bolster
Engine truck wheels	33 inches, Paige steel-tired spoke center
Style of boiler	Extended wagon top
Outside diameter of first ring	56 inches
Working pressure	190 pounds
Material of shell and firebox	Carbon steel
Thickness of plates in barrel and outside of firebox	7/16 inch, ½ inch, 11/16 inch and 9/16 inch
Firebox	95⅝ by 41⅝ inches
Firebox, crown staying	Radial stays, 1 inch diameter
" staybolts	Taylor iron, 1 inch diameter
Tubes, material	Charcoal iron, No. 11 W. G.
" number, diameter and length	249 — 2-inch O. D., by 13 feet 3 inches
Heating surface, tubes	1,716.6 square feet
" " water tubes	14.7 square feet
" " firebox	135 3 square feet
" " total	1,866.6 square feet
Grate surface	27.35 square feet
Exhaust pipes	Smith triple expansion exhaust pipe
Boiler supplied by	Two No. 9 Monitor injectors, 1888 style
Tender, weight, empty	40,800 pounds
Wheels	8 Paige steel-tired spoke center, 36 inches diameter
Journals	4½ inches diameter by 8 inches
Wheel-base	15 feet
Tender frame	10-inch steel channel
Water capacity	4,000 U. S. gallons
Coal "	6¼ (2,000-pound) tons
Total wheel-base of engine and tender	47 feet 7¾ inches
" length " " "	56 feet 8¼ inches

The engine is provided with the American brake on all drivers, operated by air; the Westinghouse automatic air brake on tender and for train, and the Westinghouse air signal; magnesia sectional boiler lagging, Gould coupler on pilot and rear of tender, Cleveland Railway Supply Company's sand blast, Hudson bell ringer, National hollow brake beams, Sherburn 5-inch chime whistle, a water scoop on tender, and two 3-inch Ashton muffled safety valves.

A Court Decision on the Manufacture of Parts of Pressed Steel Car Trucks.

Judge Atcheson, of the United States District Court, last month rendered a decision in the suit of the Fox Solid Pressed Steel Company vs. Chas. T. Schoen and the Schoen Manufacturing Company, the full text of which is as follows:

On and prior to Oct. 10, 1891, the date of the written contract between the plaintiffs, as party of the first part, and the defendants, as parties of the second part, both parties were engaged in the manufacture of center-plates for car-trucks under patents owned by them respectively, the plaintiff at Chicago, Ill., and the defendants at Pittsburg, Pa. By the terms of the contract the plaintiff

granted to the defendants the exclusive right to make center-plates under the plaintiff's patents, and the defendants agreed to pay to the plaintiff seven and one-half per centum of the gross selling price of all center-plates sold by them; and it was stipulated that the plaintiff should have the right to make center-plates "for application to pressed metal truck frames manufactured by it," upon the payment of a named royalty, but should not otherwise engage in the manufacture of center-plates. The contract contains this provision:

"It is further agreed that the parties of the second part will not engage during the life of this agreement in the manufacture of truck frames for moving vehicles or any part of such frames when made of pressed metal."

The present controversy grows out of a difference between the parties as to the meaning of this clause. The plaintiff contends that the clause prohibits the defendants not only from making pressed metal truck frames and parts of such frames, but also from making out of pressed metal any part of a truck frame of whatsoever kind the truck frame may be.

The defendants maintain that the prohibition is against the making of pressed metal truck frames and parts of a pressed metal truck frame.

If the literal reading of the clause were determining, the plaintiff's construction might be entitled to preference. But in the interpretation of a particular clause of a contract the Court is required to examine the entire instrument, and may also consider the relations of the parties, their connection with the subject matter of the contract and the circumstances under which it was made. *Rock Island Railway v. Rio Grande Railroad*, 143 U. S., 596. Moreover, the practical interpretation by the parties of an ambiguous clause of a contract is entitled to great, if not controlling, influence: *Topliff v. Topliff*, 122 U. S., 121; and such practical construction, though at variance with the literal meaning of the clause, will prevail. *District of Columbia v. Gallaher*, 124 U. S., 505. Let us apply these principles here and see with what result.

From an examination of the whole paper of Oct. 10, 1891, it is very clear that its main purpose was to regulate the manufacture of center-plates as between the parties. The clause in question is secondary and incidental. Its introduction at all into the paper would be inexplicable were it not that the plaintiff was engaged in the manufacture of pressed metal truck frames, as the contract itself discloses. That style of truck frame was peculiar, and was of comparatively recent origin and of limited use. The truck in ordnary use was, and is, the diamond truck, 85 or 90 per centum of all the railroad freight cars in the United States being provided ther e with. The diamond truck frame and the pressed metal truck frame are entirely different constructions.

The plaintiff was not engaged in the manufacture of diamond truck frames. Its business was the manufacture of pressed metal truck frames. The plaintiff was thus interested to avoid rivalry in that particular branch of business, the manufacture of pressed metal truck frames and parts of such frames. The parties entered into the contract with the Fox pressed steel truck frame before them and with reference to the plaintiff's manufacture thereof. To the extent, then, that the restrictive clause secured the plaintiff freedom from competition in the manufacture of pressed metal truck frames and parts thereof, it may be regarded as having a basis in reason. But to carry the provision further would be unnecessary for the fair protection of the plaintiff and unreasonable.

Again, at the date of the contract the defendants were engaged in the manufacture of pressed metal parts of diamond truck frames, and thereafter the defendants continued such manufacture with the knowledge of the plaintiff's principal officials and without objection. This course of manufacture by the defendants was acquiesced in by the plaintiff until about the time of the filing of this bill, on April 18, 1895. It is significant that the bill states that up until February, 1895, the defendants had complied with the terms of the contract. The occasion for the filing of the bill was that in February, 1895, the defendants began making and selling a pressed steel truck bolster. Whether the truck bolster is any part of a truck frame is a contested point. Now, without discussing the evidence, it is enough for me to say that, influenced by the weight of the testimony of the practical experts, and from my inspection of the models, my conclusion is that the bolster is no part of the truck frame. Moreover, no truck bolster is used with a pressed metal truck frame. I am, then, quite unable to see how the plaintiff can justly claim that the manufacture of the bolster is within the prohibitory clause of this contract.

Upon the question of the proper construction of this clause, my opinion, under all the circumstances of the case, accords with the view upon which the defendants insist.

But finally, if, as the plantiff contends, this clause really interdicts the defendants' manufacture out of pressed metal of any part of a diamond truck frame, then the clause, in my judgment, is in unreasonable restraint of trade and not enforcible. *Oregon Steam Navigation Co. v. Winsor*, 20 Wall, 64; *Gibbs v. Baltimore Gas Co.*, 130 U. S., 396, 409. The public interest is much promoted by the use of pressed metal parts in the repair or improvement of diamond truck frames. Now, the plaintiff's business is the manufacture of pressed metal truck frames, and the evidence shows that its manufacturing capacity is fully taxed to meet the demand for that class of truck frames. This prohibitory clause, it will be observed, is without limit as respects place. To enforce it by the injunction here sought would be to deprive the public of the defendants' needed industry, and this, too, without reasonable benefit to the plaintiff. The covenants in restraint of trade hitherto sustained have been those connected with the sale or purchase of a business and its goodwill or some analogous subject matter, where the restraint was no more extensive than was reasonably necessary for the protection of the convenantee. *Nester v. Continental Brewing Co.*, 161 Pa., 473, 481. Here, however, there was no sale or purchase of any business relating to the manufacture of truck frames, and no circumstances existed to justify so sweeping a restriction as the plaintiff claims.

Let a decree be drawn dismissing the bill with costs.

The Decision on Coupler Repair Parts Reversed.

The United States Circuit Court of Appeals last month reversed the decision in the lower courts in the case of the St. Louis Car Coupler Company vs. Shickle, Harrison and Howard Iron Company The lower court had decided that the latter concern infringed the patents of the St. Louis Car Coupler Company in supporting St. Louis coupler knuckles to railroads to replace broken ones. The Shickle Harrison and Iron Company appealed, and from the decision of the higher court in their favor we take the following:

"All the claims of the patents are of the class known as combination claims, in which the several parts of the device are claimed in combination in several different ways. Counsel for the complainant admits that the proof at the trial did not show that the defendant had either manufactured or sold, or offered to sell the complete coupler. He claims, however, and of that fact there is no doubt, that the defendant has manufactured and sold that part of the device, which, in the specification is termed the 'coupling head,' or 'knuckle.' It is accordingly insisted that the manufacture and sale of that part of the device, without the consent of the complainant, constitutes an infringement of the patents.

"The question to be determined, therefore, is whether the manufacture and sale of knuckles for the sole purpose repairing broken couplers, to persons or corporations who had previously purchased such patent couplers from the complainant, and were entittled to use them on their cars—constitutes, in law, an infringement of the patents. The decision of this question turns on the further inquiry whether the purchase of new knuckles by said railroad companies, and the substitution of the same in place of other knuckles that had been worn out or broken, amounted to a reconstruction or a repair of the couplers which were then in use. If the respective railway companies who had bought couplers which were covered by the patents in suit, had the right to rapair them to the extent of replacing knuckles that had been broken, then it is obvious that they had the right to employ the defendant company to make the knuckles for that purpose, and the latter company incurred no liability by so doing.

"The rule is well established that one who purchases a machine or mechanical contrivance, consisting of several distinct parts, which, as a whole, is covered by a patent, has the right, by virtue of his purchase from the patentee, to repair a part of the machine or device which happens to be broken through accident, or which becomes so far worn as to render the machine inoperative, provided the machine, as a whole, still retains its identity, and what is done in the way of rendering it operative does not amount to reconstruction; and provided further, that the part so replaced is not separately covered by a patent.

"The Circuit Court concluded that the manufacture and substitution of new kuckles for those which had been broken, should be regarded as a reconstruction of the car coupler, rather than a repair. It was led to entertain this view, as it seems, because it regarded the knuckle as the chief element of the patented combination; also because the knuckle is unique in form and structure and only susceptible of use in connection with the other elements of the complainant's device. But we are not able to say the substitution of new knuckles for others that had been broken should be regarded as a reconstruction of the coupler.

"The proof shows that it is much more liable to be broken than other parts of the coupling device. It is not wholly accurate to say that the knuckle is the chief element of the combination. Neither can we say that the knuckle is the only part of the coupler which affords evidence of invention.

"In view of the foregoing considerations we think that a purchaser of the patent coupling device should be accorded the right

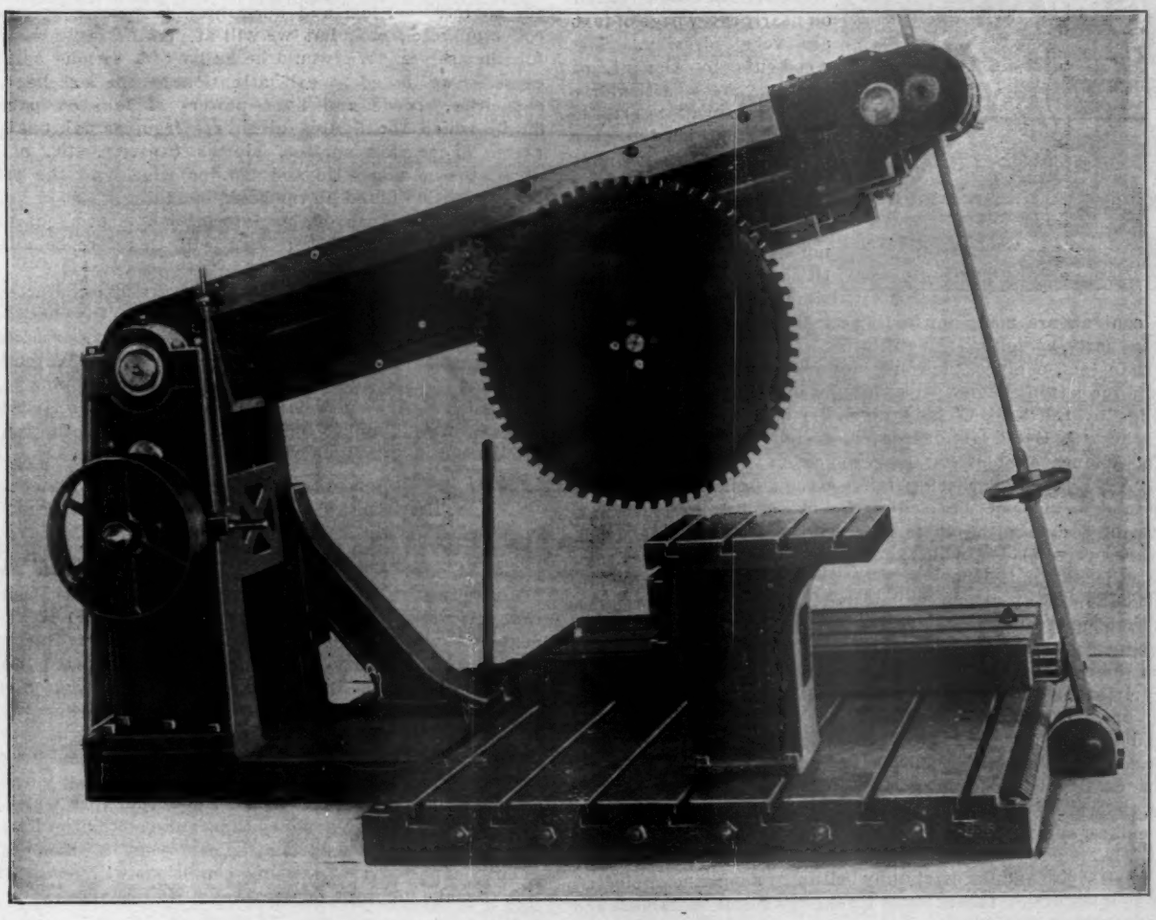
to replace a broken knuckle without the payment of an additional royalty, provided the drawheads remain intact and serviceable.

"It must be borne in mind, however, that the right to manufacture and sell the knuckle in question, should be confined strictly within the limits stated. We would not be understood as deciding that the defendant company has the right to manufacture the knuckles which form a part of the complainant's device, and to sell them indiscriminately to all persons who see fit to buy them, for clearly such is not the law. We have no doubt that the defendant would be liable as an infringer, if it so happened that the knuckles by it made and sold should be used by the purchasers in the construction of complete couplers such as are described in the complainant's patents. Therefore, if the defendant continues to manufacture the coupling-heads, or knuckles, and keeps them in stock, it must see to it that they are sold for the purpose of repairing the patent coupling device, to persons or corporations who have acquired the right to make and use them for that purpose.

"The decree of the Circuit Court is accordingly reversed, and the case is remanded to that court with directions to dismiss the bill of complaint at the complainant's cost."

No. XXXXX Power Sawing Machine.

The Q & C Company, of Chicago, has recently brought out a new Bryant Saw, called XXXXX, and shown in the annexed cut. It is constructed especially to meet the needs of steel casting works and foundries, where it is necessary to cut off shrink heads or risers of quite large size from engine drivers, gear blanks, propeller blades, and other large and irregularly shaped castings, difficult to handle in the ordinary methods. This saw supplies a recognized want hitherto unprovided for, and is one of the many special machines which the Q & C Company has produced for customers whose needs are peculiar to their own line of work.



The Q & C Company's XXXXX Power Sawing Machine.

The design gives a large unobstructed table for holding the work, the overhanging arm containing all the driving and feeding mechanism, making it a very desirable tool for such work as mentioned above. The saw being 36 inches in diameter allows 15 inches available for cutting, making it possible to cut off a shrink head 15 inches in diameter, or a solid piece of metal 15 inches thick by 24 inches long.

The engraving also shows that the saw-blade overhangs its bearings, or in other words, has one unobstructed face. This allows the operator to place the work as close to the saw as it is possible, and the cut actually finishes the casting, it not being necessary to use a planer or milling machine after the saw has completed its work. One operator can also handle the heaviest cuts.

The illustration does not give an accurate idea of the size of the machine. It weighs nearly seven tons, the metal being distributed in such a way as to give great strength and rigidity. The adjustable sprocket is another advantage over any previous design. The centers between the saws and sprocket are adjusted closer together as they wear down, doing away with the necessity of enlarged sprockets to compensate for wear. The sprockets are made of cast steel, and are small in size, thereby greatly increasing the leverage.

This first machine was built to the order of the Sargeant Steel Casting Company, of Chicago, whose large and rapidly increasing business made the saw a necessity. In a letter given by them to the Q & C Company, they express the greatest satisfaction in its use, this one machine largely increasing the output of their work. They recently cut off a shrink head 15 inches in diameter in 28 minutes.

The saw is fully guaranteed, and is sent out on the basis of entire satisfaction or no sale.

Further information regarding this or any other saw will be cheerfully sent to all parties interested by addressing the Q & C Company, Chicago, Ill.

All a Mistake.

The reporter that had accompanied the special train to the scene of the wreck hurried down the embankment and found a man who had one arm in a sling, a bandage over one eye, his front teeth gone, and his nose knocked four points to starboard, sitting on a piece of the locomotive, and surveying the horrible ruin about him.

"Can you give me some particulars of this accident?" he asked, taking out his note-book.

"I haven't heard of any accident, young man," replied the disfigured party, stiffly.

He was one of the directors of the company.—*New South Wales Railway Budget.*

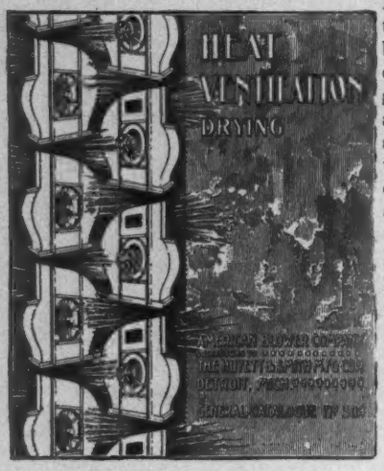
Trade Catalogues.

[In 1894 the Master Car-Builders' Association, for convenience in the filing and preservation of pamphlets, catalogues, specifications, etc., adopted a number of standard sizes. These are given here in order that the size of the publications of this kind, which are noticed under this head, may be compared with the standards, and it may be known whether they conform thereto.

It seems very desirable that all trade catalogues published should conform to the standard sizes adopted by the Master Car-Builders' Association, and therefore in noticing catalogues hereafter it will be stated in brackets whether they are or are not of one of the standard sizes.]

HEAT, VENTILATION, DRYING. American Blower Company, successors to the Huyett & Smith Manufacturing Company. Detroit, Michigan. General Catalogue No. 30. 207 pages, 7½x8¾ inches. (Not standard size.)

This book is a fine piece of catalogue work, whether viewed from an artistic standpoint or measured by the value of its contents. It is printed in three colors throughout, on the best of book paper, and nothing could be better than its engravings. The title pages and headings are handsome, and the marginal vignetted half-tones found on nearly every page of text are very pleasing. The wood-cuts by Conant, of Boston, are particularly fine. The cover is of artistic design, on which a number of blowers are represented as delivering great quantities of air across the page, but their united efforts are not sufficient to obscure the title. We give a small facsimile of the design.



The contents are made unusually accessible and are divided into thirteen parts, as follows: Ventilating fans, steel-plate blowers and exhausters, engines, pressure blowers, exhaust fans for shavings and for cotton, steam specialties, hot blast apparatus, heating buildings by the "A B C" fan system, dry ng of lumber, drying of brick, the "A B C" laundry dryer, drying of leather, tobacco, etc., miscellaneous tables and telegraph code.

The "A B C" disc ventilating fan is given a prominent place in the catalogue. One of the leading features of its construction is the use of a disc on the shaft, to which the blades are attached. There are twelve blades, which the makers claim is four more than in any other fan on the market. The object of the disc is to prevent backflow of air, which will be understood when it is remembered that the speed of the blades at their tips is high and the propulsive force great, and that as the center of rotation is approached both of these factors decrease rapidly and finally become zero. Consequently, when a fan without a disc center is working against a certain pressure any additional speed will not increase the delivery but will simply force the air back between the blades near the center. The disc prevents the back flow, and the company claim in this catalogue that the positive delivery thus secured avoids waste, that the fan can be used against a higher pressure than other makes, and will deliver from one-third to one-half more air with the same power than any other fan built. These fans are made in all styles and for driving by belt or by an engine or electric motor coupled direct, these latter forms being self-contained and very compact arrangements.

The "A B C" steel-plate blowers and exhausters made by the company are also fully illustrated. These are made with full or three-quarter housings, with the discharge opening facing any direction desired and arranged to be driven by belt or direct by engines or motors. One valuable feature of this part of the catalogue, and in fact of all its sections, is that diagrams of the apparatus are shown with letters in the places for dimensions and the value of these letters for each size and type of apparatus fully tabulated. The value of this information will be fully appreciated by engineers and architects.

In the part of the catalogue devoted to pressure-blowers the double-discharge blower is sure to attract attention. The catalogue says that "it has been practically demonstrated that the vane of a fan or blower becomes loaded with air in about one-third of a revolution"; in this blower advantage of this fact is taken and two discharges per revolution are provided for, and it is claimed that twice the delivery of a single-discharge blower is secured. The two discharges are carried to the one pipe and the outside appearance of the blower is not materially different from the single-delivery blowers.

The "A B C" steel plate exhaust fans for handling shavings are so designed that the removal of a few bolts will permit the casing to be rotated to any desired angle in order that the direction of delivery may be changed. The pulley can also be changed from one side of the casing to the other. Thus a fan can be made to fit into any desired location.

In the part of the book devoted to hot blast apparatus the new heater of the company is among the novelties shown. In a heater in which the pipes rise vertically, then run horizontally and extend down into the base again, the outer pipes are always much longer than the inner ones, giving rise to a defect which may be described as a "short circuit"—that is, the steam abandons the long pipes and takes the short route. In the new "A B C" heater the pipes are all made of practically the same length by putting numerous return bends in the inner pipes, and all the heating surface is thus maintained at full value. By a special construction of the base the trouble with "air binding" is also avoided. These heaters are shown in many combinations suited to various kinds of work.

We might describe many other features of the company's output as illustrated in this catalogue, did our space permit, such as the engines, vertical and horizontal, the steam specialties, dust collectors, etc., etc., but we will at present leave these to speak for themselves. We would be guilty of a serious omission, however, if we failed to call attention to the excellent tables of capacities, speeds and horse-powers of fans on pages 24 and 32, in which the figures given are from actual trials, and the tables of heating surface, blower capacity, etc., of hot blast apparatus on pages 116 and 120, inclusive, and the other tables of information found in the book, including those on pages 187 to 196, inclusive. Much of this information is of a character often withheld by manufacturers, and will, therefore, be all the more appreciated.

After thus calling attention to the progressive character of a number of the company's designs, it is needless to say that they are prepared to furnish apparatus for any kind of drying processes, and for heating and ventilating shops, office buildings, churches, schools, theaters, and any and every kind of a structure; in fact, apparatus adapted to all these uses is illustrated in this book. To those of our readers called upon to consider any heating, ventilating or drying problems, this catalogue will be found invaluable.

National Association of Manufacturers.

The date for holding the Second Annual Convention of the National Association of Manufacturers has been fixed for the 26th, 27th and 28th of January, 1897, at Philadelphia, Pa. It is expected that this convention will be one of unusual interest, as the President will submit a report of the first full year of practical work in the lines mapped out by the original convention held in Cincinnati, January, 1895. This report will describe the initiation of practical movement in the direction of the cardinal principles originally adopted by the association, and very gratifying progress in various directions will be noted. It will then devolve upon the convention itself, which will embrace the recorded members holding certificates in the association, to pass upon the work which has been done, and to indicate a policy to be pursued by the President and Executive Committee during the next year, in which year it is confidently expected that existing conditions will enable the association to make vigorous progress.

Dixon's Waterproof Graphite Grease for Signal Work.

A report to the Engineer Maintenance of Way by the Supervisor of Signals on a leading trunk line shows most satisfactory results obtained with waterproof graphite grease, manufactured by the Joseph Dixon Crucible Company, Jersey City, N. J.

At one point, from Oct. 1 to Nov. 28, ¼ pound of the waterproof graphite grease was used on locks, cranks and compensations on the outside and on the machine in the tower. The cost of putting it on was found to be very little more than oil. The same test was made at another point on the road with the same good result. The Supervisor found the waterproof graphite grease better than any other kind of lubricant, as it can be applied quickly and stays where it is put. It is also clean and the water has no effect upon it. Therefore the Supervisor strongly recommends the use of this grease for all the places named above.

As the graphite used in the manufacture of this grease is Dixon's pure flake graphite, the lubricating qualities are easily understood, and if the waterproof qualities are all the manufacturers claim, and the tests seem to demonstrate, its economy and usefulness for all bearing and exposed parts of railway signals are very evident.

Will Adopt the Air-Lift System of Pumping.

We learn that the Wainwright Brewery, St. Louis, is to change its entire system of pumping, having made extensive tests during the past summer as to the most efficient and economical method for its especial needs. It has decided to use the air lift and direct air pressure systems. The air compressor for the low-pressure service, consisting of Halsey pneumatic pumps, will be a Rand cross-compound condensing engine with duplex air cylinders, built by the Rand Drill Company, and of their latest approved type. A second compressor, built by the same company and of special construction, fitted with hooded heads, will take air at initial pressure of about 50 pounds from the main air receiver and compress up to 125 pounds for the air-lift system.

The Pneumatic Engineering Company, 100 Broadway, New York, has the contract for the entire plant.

EQUIPMENT AND MANUFACTURING NOTES.

The Colorado Midland expects to order 200 box cars.

The Ohio Central is said to be in the market for 10 locomotives.

The Wisconsin Central will soon place an order for 200 furniture cars.

The Seaboard Air Line is about to place orders for 12 locomotives.

It is said that the M., K. & T. will soon order a number of locomotives.

The St. Louis & San Francisco has ordered 300 coal cars from the St. Charles Car Company.

The Indianapolis Car Works are building 50 stock cars for the Mather Stock Car Company.

The Brooks Locomotive Works has an order for five locomotives for the Mexican Central Railway.

The Cold Blast Transportation Company, of Kansas City, is asking bids on 100 refrigerator cars.

The Grand Rapids & Indiana is asking bids on about 200 cars, of which about 75 are wanted at once.

The Baldwin Locomotive Works is building seven consolidation locomotives for the Norfolk & Western.

The Chesapeake & Ohio has placed an order for six consolidation locomotives with the Richmond Locomotive Works.

The Universal Construction Company, of Chicago, will build 10 steel flat cars for the Chicago, Lake Shore & Eastern.

The Barney & Smith Car Company is building a dining car, a sleeper and a library car for President Diaz, of Mexico.

The Union Pacific, Denver & Gulf is getting bids on 50 flat cars. Last month it ordered six locomotives from the Baldwin Works.

The Texas Midland expects to order 100 flat cars at an early date and six locomotives. It placed one order for 50 cars last month.

The Armour Packing Company has ordered 100 refrigerator cars for the St. Charles Car Company, and expect to place contracts for 200 more.

The Baldwin Locomotive Works have received an order for 25 locomotives, and the Schenectady Locomotive Works 18 locomotives for Japan.

The Bangor & Aroostook has ordered from the Jackson & Woodin Manufacturing Company, Berwick, Pa., 408 flat cars, 185 box cars, and 5 cabooses.

It is stated that the C., C., C. & St. L. Ry. is to build a sample box car of 80,000 pounds capacity, and that the C. & E. I. will construct a 70,000-pound car.

The Chicago, New York & Boston Transportation Company expects to build 125 refrigerator cars at its Elgin shops; 25 of these are now under construction.

The Baltimore and Ohio has placed an order for 1,000 cars with the Missouri Car & Foundry Company. The cars are for the Fairport Warehouse & Elevator Company.

The Rogers Locomotive Works will build 18 Mogul locomotives for the Imperial Japanese Railroad. They will have Latrobe tires, Nathan lubricators, Sellers injectors, Crosby gages and Richardson balanced valves.

The 1,000 Illinois Central cars recently ordered are to be equipped with Chicago rabbeted grain doors, Schoen pressed steel center plates, and Chicago roofs; some of the cars will be equipped with springs furnished by the Chas. Scott Spring Company.

The Kansas City, Pittsburgh & Gulf has placed an order for 200 stock cars, and its programme for 1897 is said to include 1,000 new cars. It will soon be in the market for six locomotives.

The Buffalo, Rochester & Pittsburgh has put into service a mammoth Mogul engine, reported to weigh 184,000 pounds without the tender, and it contemplates ordering seven of these engines.

The Wilmington & Northern has invited bids on 200 gondola cars. The specifications call for Lobdell wheels, Crown bronze or Ajax metal bearings, Butler drawbar attachments, Gould couplers, Westinghouse brakes and Fox trucks.

The American Engine Company, Bound Brook, N. J., has shipped an engine to the Chinese government for use in driving machinery for the coinage of silver.

The Norwalk Iron Works Company, South Norwalk, Conn., have purchased a large piece of ground near their plant, and propose to build on it a one-story machine shop 80 by 300 feet, by which their facilities will be greatly increased.

The Gould Coupler Company has done a large foreign business during the year now drawing to a close, having supplied couplers and vestibule equipments for something over 155 cars on European roads.

The Supreme Court has set the third Monday (18th) in January, 1897, for re-argument of the cases of Westinghouse vs. Boyden, brought from the United States Circuit Court of Appeals upon a writ of certiorari.

The Harrisburg Foundry and Machine Works, Harrisburg, Pa., are rushing a large engine to be shipped to Rio de Janeiro, Brazil. This engine will be placed in the official residence of the President of Brazil, to furnish power for electric lighting.

A press dispatch says that a local syndicate has offered the par value on all bonds and 75 per cent. on the capital stock of $800,000 for the purchase of the Dickson Manufacturing Company's locomotive and machinery plant in Scranton.

The Ramapo Wheel & Foundry Company, of Ramapo, N. Y., recently shipped an order of 80 pairs of 36-inch Snow's boltless steel-tired wheels, and steel axles, to Brazil, for the service of the Paulista Railway. The order also includes 120 loose tires and 120 loose axles.

The A. French Spring Company has an order from the government for large springs to take up the recoil of heavy guns after discharge. Experiments so far made indicate success to a degree which gives promise of an extensive use of springs for this purpose in the future.

It is reported that there is a movement on foot among the manufacturers of woodworking machinery to effect a consolidation of a large number of the firms engaged in this business, and that Mr. T. P. Egan, of the J. A. Fay & Egan Company, and the S. A. Wood Machine Company are largely interested. It is rumored that the consolidation will be largely backed by English capitalists.

The Secretary of the Navy recently awarded contracts for gun forging as follows: Eight sets of 13-inch rifle forgings to the Bethlehem Iron Works, deliveries to begin in 120 days and to be completed in 365 days; six sets of 13-inch and one set of 12-inch rifle forgings to the Midvale Steel Company, deliveries to begin in 160 days and to be completed in 340 days. The price in both cases is 23 8-10 cents per pound.

The new steel ferryboat *St. Louis*, which was built for the Pennsylvania Railroad Company by the Charles Hillman Shipbuilding Company, of Philadelphia, left the latter city Dec. 24 for New York in tow of an ocean tug. The *St. Louis* and a sister boat, the *Pittsburgh*, which is now being built by the Cramps, will ply between New York and Jersey City. They are the twin-screw ferryboats already described in these pages.

Messrs. W. A. Crook & Bros. Company, of Newark, N. J., have in press their 1897 catalogue. It will consist of 130 pages, liberally illustated and showing all the latest improvements in hoisting engines adapted for every purpose.

The catalogue will cover the entire field in this class of machinery. Applications for the new work will be received now by the W. A. Crook & Bros. Company, and copies sent out as soon as possible after publication.

The Railroad Supply Company, of Chicago, has issued an "edition de luxe" of Chicago Day Souvenir, in which is reproduced many interesting photographs of the great sound-money parade in Chicago taken as different divisions of it passed the company's offices in the Owens Building. The souvenir also contains elegant engraving illustrating the company's specialties, such as tie plates, journal-box lifters, Hien car couplers and cattle guards. The whole work is very artistic and pleasing.

Marine engineers can obtain one of the handsomest calendars of the new year free of charge, by addressing The Roberts Safety Water Tube Boiler Company, 41 Cortland street, New York City, and giving their full names and addresses, with name of last vessel on which they were employed. These calenders are a perfect picture and even superior to those issued by the Roberts Company last year. They are sent in a mailing tube. Six cents for postage can be remitted if desired, but is not insisted upon.

The Universal Protective Paint Company, of Chicago, has recently taken out a license for incorporation, and intends soon to move its factory from Lockport to West Chicago, where it will have better facilities for the manufacture of its line of rustless paints, which are so rapidly gaining popular favor. The protective and lasting qualities of "Irown," whether applied to wood or iron, are becoming recognized, which makes a change to larger quarters a necessity. The office of the company will remain at No. 77 Clark street.

The suit of the Morris Box Lid Company vs. The Davis Pressed Steel Company, of Wilmington, Del., for infringement on the pressed steel box lid patents of the former, was decided by the United States Court for the District of Delaware in favor of the Morris Box Lid Company, and the case referred to a Master in Chancery to report to the Court the amount of damages due the complainant. The defendant company is enjoined from making or selling the pressed steel lids covered by the patents on which the suit was decided.

A test of some important and large steel castings for the United States government made last month at the works of the Franklin Steel Casting Company gives strong testimony to the excellence of intelligently manufactured open-hearth steel. The following are the figures:

Tensile strength per square inches	72,000 pounds
Klastic limit " "	46,000 "
Elongation	27 per cent.
Reduction of area	32 "

The Sargeant Company note a decided improvement in the line of their trade specialties, brake shoes. Railroad orders are larger and more frequent. In their steel casting business general machinery trade is better, and the recent results obtained in special cast steel locomotive parts have been so successful that many inquiries have been received and orders entered for crossheads, wheel centers, frames, domes and driving boxes. The Sargeant Compny are certainly to be congratulated for having obtained their present position in the art of steel casting. The field is a large one and the Western railroad and manufacturing trade has long looked for a company on whom they could depend for first-class work.

Passenger Train Service on the Baltimore & Ohio.

Among the improvements that will be made on the Baltimore & Ohio is a radical change in the running of passenger trains. General Manager Greene has been investigating this matter for some time, and contemplates changing the number of cars per train so that they can make better time going up the heavy grades, and as a a consequence will not run so fast coming down. Now that the track has been placed in a first-class condition and new motive power purchased for the passenger trains, Mr. Greene is of the opinion that, by equalizing the weight of the trains, a trip over the Balti more & Ohio will be made very pleasant.

The track from Chicago Junction to Chicago now ranks as one of the finest in the West. It is laid with heavy steel rail and ballasted with clean gravel, and as there are very few curves on the line the trains are enabled to make high speed with perfect safety.

Every-Day Excursions

To all parts of the world can be arranged for any day in the year, for one or more persons, upon application to any principal ticket agent of the Chicago, Milwaukee & St. Paul Railway. Itineraries carefully prepared for excursions to California, Florida, Mexico, China, Japan and to any part of Europe. Estimates furnished, including all expenses. Tickets furnished for the complete journey. It is not necessary to wait for any so-called "Personally Conducted Excursions." In these days of progressive enlightenment, with the English language spoken in every land under the sun, one does not need to depend upon the services of guides for sight-seeing, but can go it alone or in small family parties, with great comfort and security, and at one's own convenience. Apply to the nearest agent of the Chicago, Milwaukee & St. Paul Railway, or address Geo. H. Heafford, General Passenger Agent, 415 Old Colony Building, Chicago, Ill.

Our Directory

OF OFFICIAL CHANGES IN DECEMBER.

We note the following changes of officers since our last issue. Information relative to such changes is solicited.

Atlantic & West Point.—Mr. R. H. Johnson has been appointed Master Mechanic, with headquarters at Montgomery, Ala.

Baltimore & Ohio.—Mr. E. H. Bankard has been appointed Purchasing Agent, vice Mr. L. J. Buckley, resigned. Mr. F. S. Gannon has resigned as Superintendent of the New York Division, and is succeeded by Mr. J. V. Smith, transferred from the general superintendency of the Trans-Ohio lines.

Boston & Maine.—Mr. Frank Barr has been appointed Assistant General Manager, vice Geo. F. Evans, resigned.

Charleston, Clendennin & Sutton.—John H. Drake; President of the company, died Oct. 21, 1896.

Chicago & Northwestern.—Mr. E. M. Herr has resigned the position of Assistant Superintendent of Motive Power.

Detroit & Mackinac.—Mr. J. D. Hawks succeeds Mr. C. H. Coster as President, and also retains the position of General Manager. Office, at Detroit, Mich. Mr. Geo. M. Crocker, Purchasing Agent is also Vice-President.

Fall River Line.—Mr. Chas. P. Clark has been elected President vice J. R. Hendricks, deceased.

Fort Worth & Denver City.—G. M. Dodge has been elected President, with office at New York. K. M. Van Zandt has been elected First Vice-President, with office at Fort Worth, Tex. Morgan Jones has been appointed General Manager.

Hutchinson & Southern.—Mr. W. A. Bradford, Jr., has been appointed General Manager, with office at Hutchinson, Kan.

Long Island.—Mr. E. R. Reynolds, General Manager, and Mr, Geo. C. Hubbell, Purchasing Agent, have resigned.

Maine Central.—On Nov. 30, 1896, the Board of Directors appointed Mr. Geo. F. Evans General Manager in place of Mr. Payson Tucker.

Manhattan.—Mr. Wm. J. Fransioli, Acting General Manager, has been appointed General Manager.

Maricopa & Phœnix & Salt River Valley.—C. C. McNiel has been appointed General Superintendent, vice Mr. E. Shamp, resigned.

Mexican Northern.—Geo. Foster Peabody has been elected First Vice-President and E. M. Shepard Second Vice-President, both with office at New York.

Mobile & Birmingham.—Mr. J. J. Thomas, Jr., has been appointed Master Mechanic, with headquarters at Mobile, Ala.

Morristown & Cumberland Gap.—Mr. Robt. T. Baker has been appointed General Superintendent, with office at Morristown, Tenn., in place of Mr. H. M. Aiken, whose title was General Manager.

New Orleans & Western.—Mr. W. C. Dotterer has been appointed General Manager, vice M. J. Turner, resigned.

New York Central & Hudson River.—Mr. Peter Smith, Master Car Builder at Rochester, N. Y., died Nov. 18.

New York, New Haven & Hartford.—Mr. J. R. Kendrick, Third Vice-President, died suddenly on Dec. 11.

New York, Philadelphia & Norfolk.—G. W. Russell has been appointed Master Mechanic, with office at Cape Charles, Va.

Northern Pacific.—Mr. John Hickey, Superintendent of Motive Power, has resigned because of ill-health, and is succeeded by Mr. E. M. Herr.

Oconee & Western.—Capt. A. E. Hatchfield, President and General Manager, died on Nov. 19.

Philadelphia & Reading.—Mr. Chas. E. Henderson has been chosen Second Vice-President, in charge of freight traffic.

San Antonio & Gulf Shore.—Mr. Henry Terrell has been appointed General Manager, with headquarters at San Antonio, Tex.

Southern.—Mr. Frank S. Gannon has been appointed Third Vice-President and General Manager, with headquarters in Washington, D. C.

Staten Island Rapid Transit.—General Manager F. S. Gannon has resigned, and is succeeded by Mr. J. V. Smith.

St. Louis, Kansas City & Southwestern.—Mr. Dwight Braman has been appointed Receiver.

Vandalia.—Purchasing Agent Mr. C. R. Peddle has removed his office from St. Louis to Indianapolis. The office of General Superintendent is abolished.

Wheeling Bridge & Terminal.—C. H. Coit has been elected Vice-President. H. W. Hayden has been elected Secretary and Treasurer, with office at New York.

Wiggins Ferry.—Mr. S. M. Dolan has been appointed Master Mechanic, with office at St. Louis.

Wiscasset & Quebec.—President Henry Ingalls died last month.

PRESSED STEEL TRUCK FRAMES

AND PRESSED STEEL PARTS FOR CAR AND TRUCK CONSTRUCTION.

FOX SOLID PRESSED STEEL CO. { GENERAL OFFICES: Fisher Building, 281 Dearborn St., Chicago. WORKS: Joliet, Illinois.

JAMES B. BRADY, GENERAL SALES AGENT, HAVEMEYER BUILDING, NEW YORK.

F. W DEVOE & CO.'S COLORS AND VARNISHES ARE STANDARDS.

THE ROBERTS SAFETY WATER TUBE BOILER.

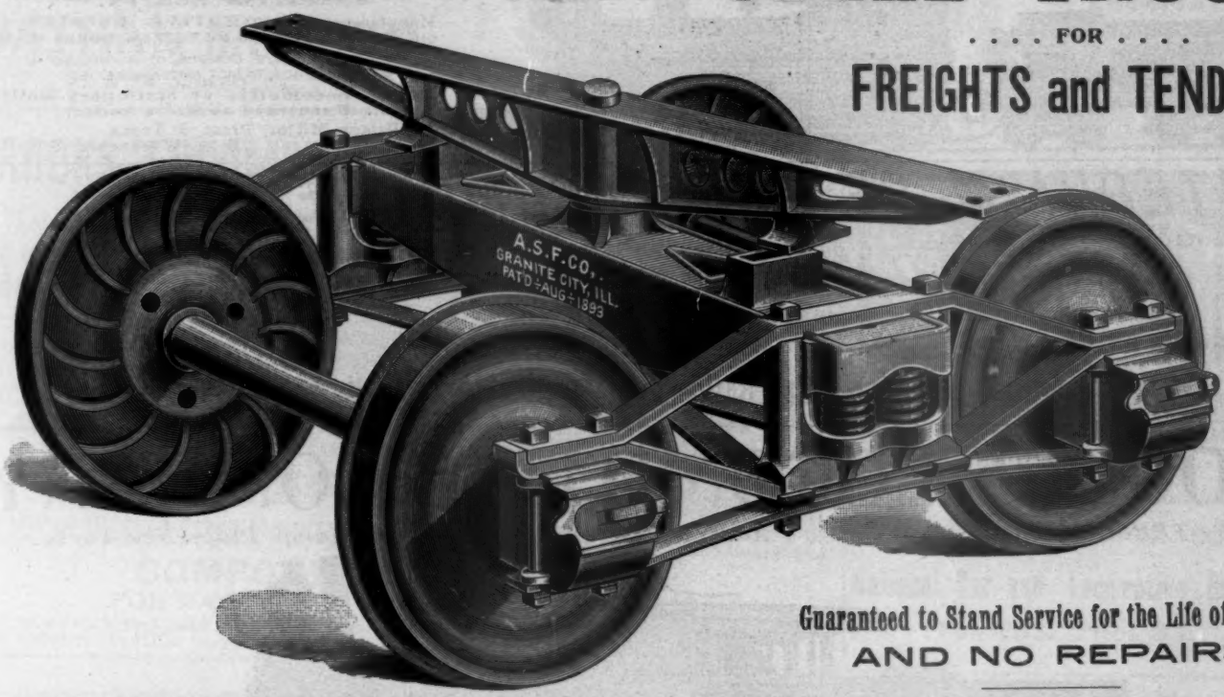
800 IN USE for Naval and Marine Purposes.

Send for Handsome Illustrated Catalogue. . . 39 CORTLANDT STREET, NEW YORK.

THE AMERICAN STEEL TRUCK

. . . . FOR . . . .

FREIGHTS and TENDERS.



MADE OF

Soft Open-Hearth Basic Steel.

Guaranteed to Stand Service for the Life of the Car AND NO REPAIRS

AMERICAN STEEL FOUNDRY CO., ST. LOUIS, MO., U. S. A. Send for Descriptive Circular.

Armstrong Tool Holders.

For Turning, Planing and Boring Metals.

50,000 ALREADY IN USE.

SEND FOR CATALOGUE.

ARMSTRONG BROS. TOOL CO., No. 98 West Washington St., Chicago.

BAKER CAR HEATERS

SPECIAL FITTINGS FOR BAKER HEATER WORK.

FLEXIBLE STEEL FIREPROOF HEATERS

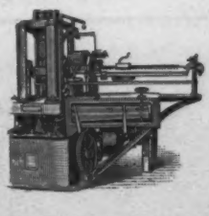
FIVE OTHER STYLES.

Single and Double Circulations.

WILLIAM C. BAKER,

(Successor to Baker Heating Co.)

143 LIBERTY ST., NEW YORK.



OLSEN'S Testing Machines

FOR TESTING Iron Specimens, Bridge Materials, Chain, Cement, Wire Springs, Etc.

Hydraulic Presses, Accumulators, Gauges & Pumps.

Awarded Medal of Merit at The World's Fair.

TINIUS OLSEN & CO., 500 N. 12th St., Philadelphia, Pa.

FREE SAMPLE COPY OF HOME STUDY,

. . . An Elementary Journal for Students

Of Mechanics, Electricity, Architecture, Mining, Plumbing, Heating and Ventilation, Steam Engineering, Civil Engineering and Mechanical and Architectural Drawing. Address

HOME STUDY, Box 985, SCRANTON, PA.

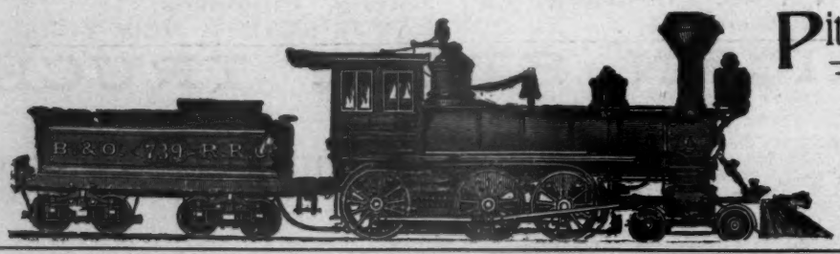
SEND $3.00 to the AMERICAN ENGINEER, Morse Bldg., New York City, for the best book on American Cars ever published.

THOMAS PROSSER & SON,
15 GOLD STREET,
NEW YORK.
Old Colony Building, Chicago.

KRUPP STEEL TIRES

On Locomotive Driving Wheels and on Steel-Tired Wheels

GIVE THE BEST RESULTS - - - FOR EVERY VARIETY OF SERVICE.



Pittsburgh Locomotive and Car Works.

PITTSBURGH, PA.
Manufacturers of LOCOMOTIVE ENGINES for Broad or Narrow Gauge Roads
From standard designs, or according to specifications, to suit purchasers.
Tanks, Locomotive or Stationary Boilers Furnished at Short Notice.
Wilson Miller, Prest. & Treas.
D. A. Wightman, Supt.

CATECHISM OF THE LOCOMOTIVE

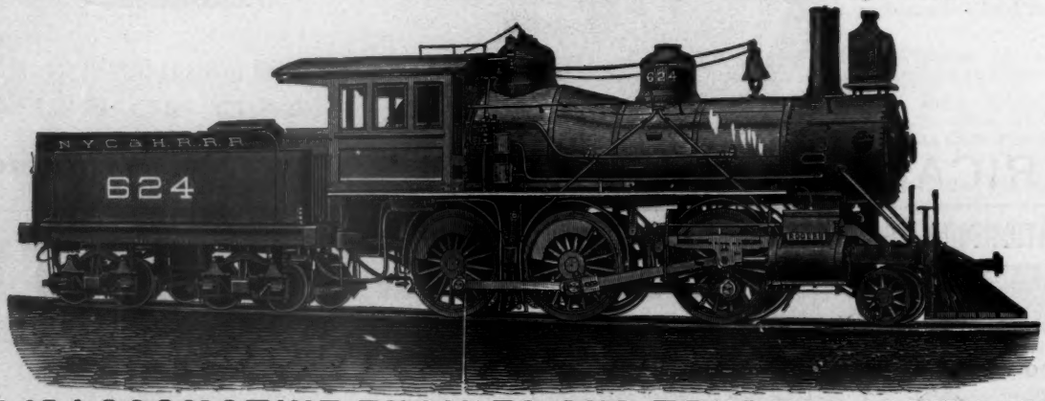
For seventeen years it has been the best authority and almost a necessity to every Locomotive Engineer and Fireman, and on many railroads it is the standard for examination of Fireman for promotion. PRICE $3.50.

FOR SALE BY : :

American Engineer, Car Builder and Railroad Journal, Morse Building, N. Y. City.

ROGERS LOCOMOTIVE COMPANY

PATERSON, N. J. Address Paterson, N. J., or 44 Exchange Place, New York.



BUILDERS OF LOCOMOTIVE ENGINES AND TENDERS OF EVERY DESCRIPTION

R. S. HUGHES, President. G. S. LONGBOTTOM, Sec'y. G. E. HANNAH, Treas. REUBEN WELLS, Supt.

SCHENECTADY
Locomotive • Works,
SCHENECTADY, N. Y.

ESTABLISHED 1848.

Annual Capacity, 450.

EDWARD ELLIS, President.
WM. D. ELLIS, Vice-Pres. and Treasurer.
A. J. PITKIN, Superintendent.
A. P. STRONG, Secretary.

THE NEW "NATHAN"

(See Illustration)

And Monitor Injectors for Locomotives.

"NATHAN"

SIGHT FEED LUBRICATORS.

For Locomotive Cylinders and Air Brakes.

STEAM FIRE EXTINGUISHERS

For Switching and Yard Engines.

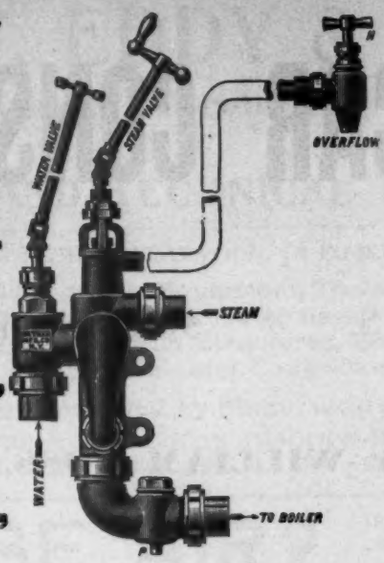
BOILER WASHERS,

Rod and Guide Oil Cups, etc.

Send for Descriptive Catalogues.

NATHAN MFG. CO.,

92 & 94 Liberty St., N. Y.



PNEUMATIC

TRACK SANDING APPARATUS

FOR LOCOMOTIVES.

H. L. LEACH, 176 Huron Ave., N. Cambridge, Mass.

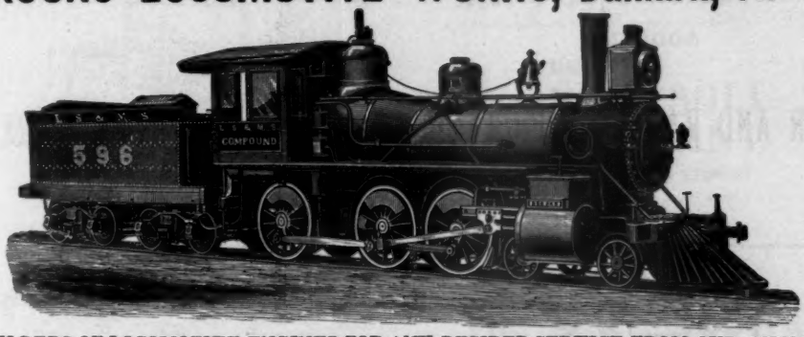
The Most Easy Working Locomotives are those that are Equipped with the

DETROIT SIGHT FEED LUBRICATORS

Our Catalogue Tells Why. Send for it.

DETROIT LUBRICATOR CO., Detroit, Mich.

BROOKS LOCOMOTIVE WORKS, Dunkirk, N. Y.



BUILDERS OF LOCOMOTIVE ENGINES FOR ANY DESIRED SERVICE FROM OUR OWN DESIGNS OR THOSE OF PURCHASER. Perfect Interchangeability and all Work fully Guaranteed.

COMPOUND LOCOMOTIVES

FOR PASSENGER AND FREIGHT SERVICE.

F. H. STEVENS, President. R. J. GROSS, Vice-Pres. M. L. HINMAN, Treasurer.
T. M. HEQUEMBOURG, Sec't'y. DAVID RUSSELL, Supt. H. TANDY, Asst. Supt.

Drawing Materials, Surveying Instruments.

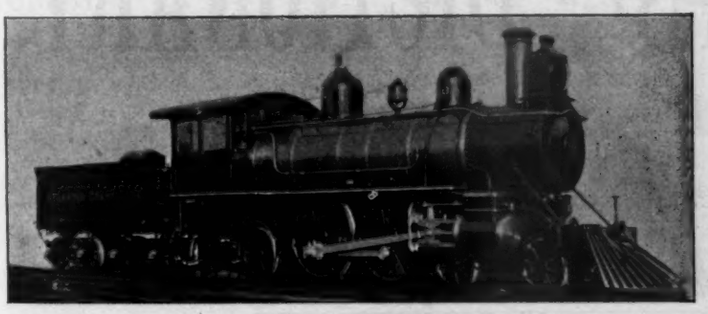
The largest and best-assorted stock in this line. The most complete catalogue. All goods warranted.

Catalogue on Application.

BOUND VOLUMES OF THE

National Car and Locomotive Builder

For 1895. Price $3.



Baldwin Locomotive Works.

Established 1831. ANNUAL CAPACITY, 1,000.

LOCOMOTIVE ENGINES

Adapted to every variety of service and built accurately to standard gauges and template. Like parts of different engines of same class perfectly interchangeable.

Single Expansion and Compound Locomotives; Electrical Locomotives; Broad and Narrow Gauge Locomotives; Mine Locomotives by Steam or Compressed Air; Plantation Locomotives; Noiseless Motors for Street Railways, Etc.

BURNHAM, WILLIAMS & CO.,

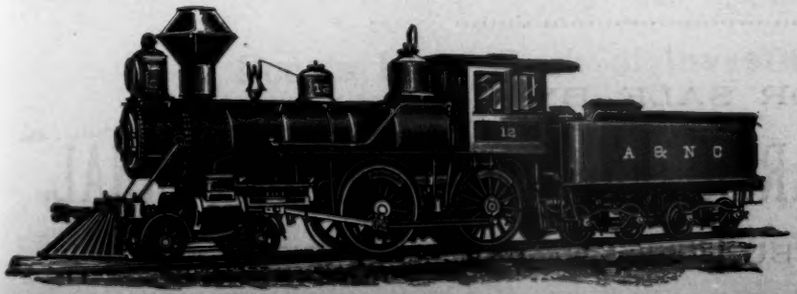
Proprietors, PHILADELPHIA, PA.

ESTABLISHED 1865.

RICHMOND LOCOMOTIVE & MACHINE WORKS,

RICHMOND, VA.

BUILDERS OF



LOCOMOTIVES

FOR EVERY VARIETY OF SERVICE.

Accurately Made to Gauges and Templates.

RAILWAY CAR CONSTRUCTION.

200 PAGES. :: 500 ENGRAVINGS.

By WILLIAM VOSS.

With Full Working Drawings of Every Style of Car Now Used on American Railroads.

. . ADDRESS . . .

AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL, Morse Building, NEW YORK

. . . NEW . . .

CAR BUILDER'S DICTIONARY.

The Handsomest and Costliest Technical Book in the World

A Liberal Education for a Railroad Officer.

PRICE $5.00.

Every Car Builder must have it. Necessary for Inspectors at Interchange Points.

FOR SALE BY

AMERICAN ENGINEER, CAR BUILDER & RAILROAD JOURNAL,

ROOM 60, MORSE BUILDING, NEW YORK CITY.

AGENCIES:
London.
Hamburg.
Rio de Janeiro.
Valparaiso.

FLINT, EDDY & CO.,

Export Merchants,

66-68 BROAD STREET, - - NEW YORK.

AGENCIES:
Sydney, Australia.
Lima, Peru.
Guayaquil, Ecuador.
Havana, Cuba.
Buenos Ayres.

ENGINEERING AND TECHNICAL DEPARTMENT.

SPECIAL EFFORTS ARE DIRECTED TO THE SOLICITATION, IN FOREIGN COUNTRIES, OF ORDERS FOR

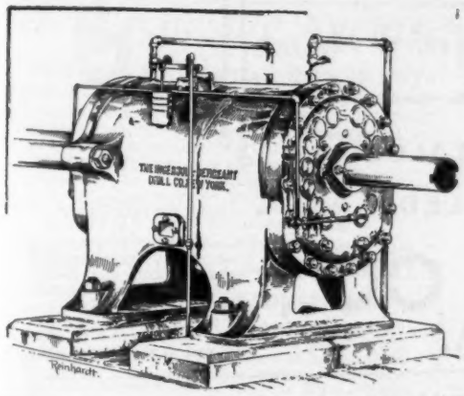
Railway Constructions, Material, Rolling Stock, Equipment, Tools and Supplies, Electric Tramwa
Lighting Plants, Electrical Appliances, Tools, Materials and Supplies for Public Works,
Bridges and other Steel and Iron Structures, General Engineering,
Equipment and Supplies and Contractors' Outfits.

Are prepared to Finance Orders received by Manufacturers from Foreign Countries.

OOK OF REFERENCE AND INFORMATION ON AMERICAN PRACTICE IN RAILROADS, PUBLIC WORKS, LAKE AND RIVER NAVIGATION, ELECTRICAL APPLIANCES AND SPECIAL INDUSTRIES.

DO YOU USE AIR?

IF YOU DON'T YOU ARE NOT KEEPING UP WITH THE TIMES



Air Compressors

OF . . .

THE

INGERSOLL-SERGEANT

make, are the highest type of machines. . . . . .

Air in the Shop saves Money.

SEND FOR CATALOGUE. : : :

Valves after 5 years of hard use.

Valve after being under a steam hammer.

The Ingersoll-Sergeant Drill Co., HAVEMEYER BLDG., NEW YORK.

29th ANNUAL NUMBER OF ...

POOR'S MANUAL

. . . OF THE . . .

Railroads of the United States

STEAM RAILROADS, Street Railway and Traction Companies.

1896

"Industrial" Corporations, National, State and Municipal Finances.

In which is incorporated the most valuable features of

POOR'S DIRECTORY OF RAILWAY OFFICIALS

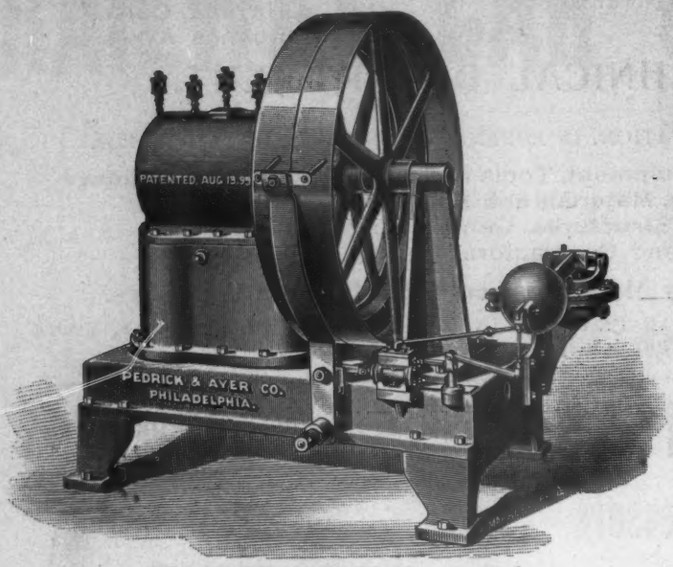
. . . AND . . .

Poor's Hand Book of Investment Securities.

In One Volume, Royal Octavo, Cloth, 1,800 Pages. ∴ *PRICE, $7.50 PER COPY*

H. V. & H. W. POOR, Publishers, 44 Broad St. (Edison Building) ... NEW YORK. ...

AUTOMATIC
COMPOUND BELT AIR COMPRESSOR.



BUILT IN TWO SIZES—Nos. 1 and 2.

Designed for Shop use to furnish Air for Pneumatic Tools. Self-regulating, automatically stopping and starting as pressure varies, using very little power. Occupies small space. As durable as is possible to make of steel and cast iron. 120 in successful operation. If interested write for Form 17 Novelty.

AIR HOSE COUPLINGS
WITH SELF-CLOSING VALVE.

Made in three sizes—¼, ½ and 1 inch. A very serviceable and quick coupling. When disconnected the flow of air is stopped. A very desirable device for connecting hoists that are to be used in different places, as the load can be raised and disconnected and the hoist or other tool moved away. By having several pendant hose with these fixtures, one hoist will serve in many places.

WRITE FOR FORM NO. 13 NOVELTY.

AIR LIFTS.

Cut represents No. 2 Built in three styles: Nos. 1, 2, 3. No. 1 style for ordinary lifting. No. 2 style has load retainer and can be adjusted for exact heights. No. 3 has an additional releasing valve for foundry work. **Write for Form No. 6 Novelty**

NEW CATALOGUE JUST ISSUED. . .

PEDRICK & AYER CO.,
STATION S, PHILADELPHIA, PA., U. S. A.

It has been demonstrated beyond question that

DIXON'S PURE FLAKE GRAPHITE

Is as necessary to the proper equipment of an engine as a monkey wrench or an oil can. It positively saves engine and valve oil, and prevents and cures hot pins and bearings.

SEND FOR SAMPLE AND TESTIMONY OF EXPERTS. JOS. DIXON CRUCIBLE CO., JERSEY CITY, N. J.

NEW
CAR BUILDER'S DICTIONARY.

The Handsomest and Costliest Technical Book in the World.

A Liberal Education for a Railroad Officer.

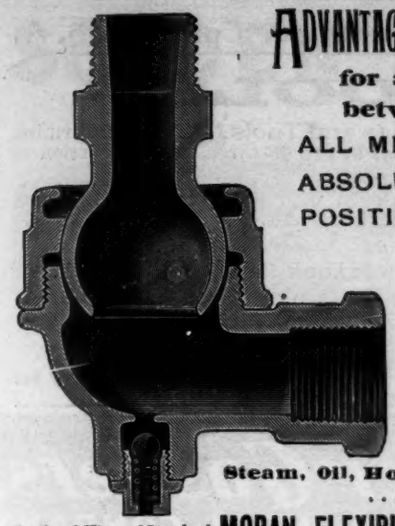
PRICE $5.00.

Every Car Builder must have it. Necessary for Inspectors at Interchange Points

FOR SALE BY

AMERICAN ENGINEER, CAR BUILDER & RAILROAD JOURNAL.

Room 60 Morse Building, New York City.



Sectional View of Standard R. R. Joint, showing Automatic Relief Trap.

ADVANTAGES OF THE MORAN FLEXIBLE JOINT

for a Steam Heating Connection between Engine and Tender. . .

ALL METAL CONNECTION,
ABSOLUTELY FLEXIBLE,
POSITIVELY STEAM TIGHT
UNDER ANY PRESSURE,
INDESTRUCTIBLE,
SHORT OF WRECK,
NO DELAYS, NO REPAIRS,
FIRST COST IS THE ONLY COST.

Steam, Oil, Hot Ashes or Dirt does not Affect Its Life.

. . . PARTICULARS ON APPLICATION. . . .

MORAN FLEXIBLE STEAM JOINT CO. (Inc'd), HENRY U. FRANKEL, President,
149 THIRD STREET, LOUISVILLE, KY.

INDEX TO ADVERTISERS.—*Continued.*

Vises:
Merrill Bros., Brooklyn, N. Y.

Water Columns:
Reliance Gauge Co., Cleveland, O.

Water Tanks:
Automatic Water Tank Co., New York, N. Y.

Water-Tube Boilers:
Almy Water-Tube Boiler Co., Providence, R. I.
Abendroth-Root Mfg. Co., New York, N. Y.
L. Boyer's Sons, New York, N. Y.
Roberts Safety, W. J. B. Co., New York.

Wells Light:
Wells Light Mfg. Co., New York City.

Wire Fences:
Page Woven Wire Fence Co., Adrian, Mich.

Wood Preserving:
Lehigh Valley Creosoting Wks., New York, N. Y.

Wrench:
Coes Wrench Co., Worcester, Mass.

Wrought Iron Pipe:
Crane & Co., Chicago, Ill.

To Purchasing Agents.

THE SHEET METAL CONTRACTING CO. make a specialty of manufacturing Special Goods in Tin, Copper, Brass and Sheet Iron for Mine, Mill, Railroad and Steamship Use. Send us your specifications and get our price.

WILKES-BARRE, PA.

Send your name for a Souvenir of the Works of Eugene Field,

FIELD FLOWERS

The Eugene Field Monument Souvenir

The most beautiful Art Production of the century. "A small bunch of the most fragrant of blossoms gathered from the broad acres of Eugene Field's Farm of Love." Contains a selection of the most beautiful of the poems of Eugene Field, Handsomely illustrated by thirty-five of the world's greatest artists as their contribution to the Monument Fund. But for the noble contributions of the great artists this book could not have been manufactured for $7.00. For sale at book stores, or sent prepaid on receipt of $1.10. The love offering to the Child's Poet Laureate, published by the Committee to create a fund to build the Monument and to care for the family of the beloved poet.

Eugene Field Monument Souvenir Fund,
180 Monroe Street, Chicago, Ill.

F. WEBER & CO.,

Engineers' and . . Draughtsmen's Supplies.

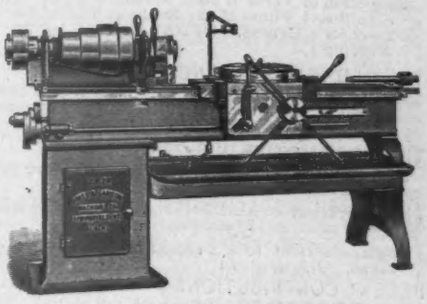
Sole Agents for Riefler's Celebrated Round System Drawing Instruments, and Ott's Pantographs and Planimeters.

Drawing and Tracing Papers, Blue Print Papers and Linen, Etc.

1125 Chestnut St., Philadelphia.

BRANCH HOUSES:

ST. LOUIS, MO. BALTIMORE, MD.



2 x 24 FLAT TURRET LATHE.

JONES & LAMSON MACHINE CO.,

SPRINGFIELD, VT., U. S. A.,

Sole Builder of the

FLAT TURRET LATHE.

Foreign Representatives: M. Koyemann, Charlotten strasse 112, Dusseldorf, Germany; Adolphe Janssens, 16 Place De La Republique, Paris, France; Charles Churchil & Co., 9-15 Leonard St., Finsbury, London, E. C., and 6, Albert St., Birmingham, England; and Henry Kelley & Co., 26, Pall Mall, Manchester, England.

"STEVEDORE"

TRADE MARK.

STEVEDORE ROPE is made for both Hoisting and Transmission Purposes from the best selected manila, laid up with plumbago. We guarantee that **MORE WORK** can be done with it, in proportion to its cost, than with any other rope in the market, without any exception whatever, and will gladly refund the difference in price if it is not all we claim.

YOU CANNOT LOSE ONE CENT

by making a trial of this rope, and are sure to reduce your expense account. All ordinary sizes are kept in stock and cut to any length desired. **BEFORE YOU FORGET IT**, purchase a length of this rope to compare with that you are now using.

C. W. HUNT COMPANY, 45 Broadway, N. Y. Established 1872.

Automatic Water Tanks

SAVE ALL PUMPING-EXPENSE

at R. R. Water Stations.

1,000 GALLONS PER MINUTE.

THE AUTOMATIC WATER TANK CO.,
143 Liberty Street, New York.

THE PRATT & WHITNEY CO., Hartford, Conn., U. S. A.

FINE MACHINE TOOLS.

Single and Double Head Milling Machines, used as substitutes for Planers for Heavy and Rapid Cutting in Cast and Wrought Iron and Steel.

Metal Band Sawing Machines for Cutting Sprues from Brass Castings.

Gages and Small Tools for General Machine Work.

Automatic Weighing Machines, a revolution in weighing and measuring.

Turret Head Machines and Tools for Turning, Forming and Threading Irregular Pieces of Circular Cross-section in Brass, Iron and Steel.

Milling Cutters, Holders, with inserted Cutters for Turning, Shaping and Threading Metals.

Spiral Shear Punches.

Forging and Trimming Dies for all classes of work.

Drop Hammers and Trimming Presses.

BUCK & HICKMAN, 280 Whitechapel Road, London, E. SCHUCHARDT & SHUTTE, Berlin and Vienna.
FENWICK FRERES & CO., 21 Rue Martel, Paris.

CHICAGO: 42 and 44 South Clinton St. **BOSTON: 281 Franklin St.** **NEW YORK: 123 Liberty St.**

SAMPLE COPY FREE.

Modern Machinery,

ASHLAND BLOCK, CHICAGO.

FROM THE JANUARY NUMBER.

KIPLING SINGS THE SONG OF STEAM,
Collection of Verse Which Presents a New and Significant Phase of the Brilliant Young Englishman's Genius. (*With Portrait of Mr. Kipling.*)

THE OLD YEAR'S DISTINGUISHED DEAD.
A Retrospect of the Prominent Men Whom the World of Machinery, Manufacture and Invention Lost During 1896. (*Illustrated.*)

THE LOCOMOTIVE IN FICTION.
How Plots in Modern Novels are Controlled by the Throttle. (*Illustrated.*)

THE FRENCH BLACKSMITH WHO HARDENS COPPER.
England's Debt to a Descendant of the Acadians. (*Illustrated.*)

RECENT CONTRIBUTIONS OF AMERICAN INVENTORS TO THE SCIENCE OF NAVAL WARFARE.
Professor Badt's Electric Sentinel for Coast Defense.
Torpedo Boat which Steers Itself Toward Hostile Warships.
The Holland Submarine Torpedo Boat.

HISTORY OF TWO GREAT INVENTIONS.
Maxim's Account of the Maxim Gun. (*With Portrait of Mr. Maxim.*)
The Late Alfred Nobel and his invention of Dynamite.

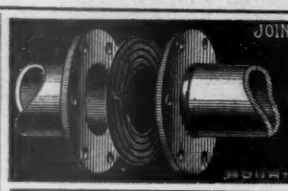
SUCCESSFUL FLIGHT OF PROF. LANGLEY'S AERODROME.
Description of the Machine and Prof. Langley's Account of His Experiments. (*Illustrated.*)

OUR EXPORT MACHINERY TRADE.
Supremacy of American Bicycle Machinery in England.
Suggestions as to the Development of Business with the Baltic Country.

THE MOTOR CAR. (*Illustrated.*)
Interest in Horseless Vehicles in England.
Preparations for the Motocycle Contest in Chicago.

MR. BADEN POWELL'S ELECTRIC ICE DESTROYER. (*Illustrated.*)

CHANGES OF A HALF CENTURY IN MACHINE TOOLS.



JOINTS MADE ABSOLUTELY TIGHT AND DURABLE BY PATENT CORRUGATED

Copper Gaskets,

U.S. MINERAL WOOL COMPANY.
2 CORTLANDT STREET, NEW YORK

RAILWAY CAR CONSTRUCTION

The Only Perfect Work on American Cars Ever Published.

Written and Compiled by WILLIAM VOSS.

200 Pages. Upward of 500 Engravings.

Price, Postage Prepaid, $3.00 Per Copy.

Remit by Bank Check, Express Money Order, P. O. Money Order or Registered Letter. Address

American Engineer, Car Builder and Railroad Journal

MORSE BUILDING, NEW YORK.

A New Locomotive Boiler Covering.

THE KELLEY FIREPROOF LAGGING CASING, WITH OR WITHOUT FILLING,

GIVES A SMOOTH SURFACE FOR JACKETING.

These Casings are made in sections and any desired length and width, either flat or curved.

They can be removed and replaced without injury. They are strong; easily adjusted without countersinking.

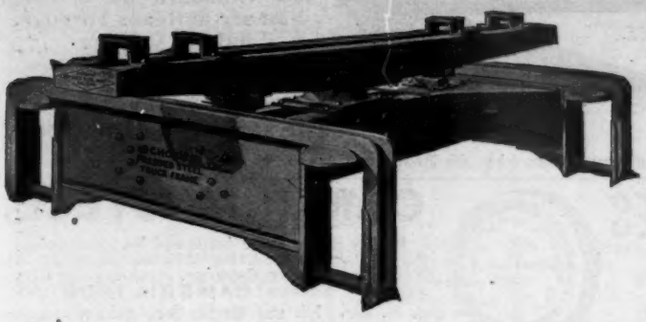
The cost is one-half that of other sectional coverings.

Samples and prices sent upon application. Correspondence solicited. Address . . . .

THE KELLEY CO.,

MINERAL POINT, WIS.

SCHOEN PRESSED STEEL CO.,



—MANUFACTURERS OF—

Truck Frames and Bolsters FOR CARS.

General Office and Works: PITTSBURGH, PA.

PHILADELPHIA: Betz Building. **CHICAGO: Monadnock Building.** **NEW YORK: 100 Broadway.**

ALPHABETICAL INDEX TO ADVERTISERS.

	PAGE
Abendroth & Root Mfg. Co	7
Acme Machinery Co	15
Ætna Standard Iron & Steel Co	46
Aitchison Perforated Metal Co	42
Ajax Metal Co	46
Albro Co., The E. D	14
Allis, The Edward P. Co	6
Allison Mfg. Co., The	9
Alteneder & Sons, Theodore	23
American Heat Insulating Co	7
American Steel Foundry Co	23
Armstrong Bros. Tool Co	23
Armstrong Mfg. Co	17
Ashton Valve Co	22
Automatic Water Tank Co	19
Babcock & Wilcox Co	4
Baker, W. C	23
Baldwin Locomotive Works	25
Bangs, E. D., Oil Cup Co	17
Bass Foundry & Machine Works	11
Becker Mfg. Co., The John	16
Bement Miles & Co	12
Big Four Route	10
Billmeyer & Small	9
Boies Steel Wheel Co	8
Boston & Albany R. R	32
Boston & Maine R. R	17
Boyer's, L., Sons	6
Boyer Ry. Speed Recorder Co	7
Bradley Car Works	9
Bridgeport Safety Emery Wheel Co	8
Brooks Locomotive Works	25
Brown Hoisting & Conveying Machine Co	4
Bruner, Sprague & Co	3
Bushnell Mfg. Co	1
Cameron, A. S., Steam Pump Co	7
Cambria Iron Co	22
Carbon Steel Co	44
Carlisle Mfg. Co	9
Central Iron & Steel Co	17
Chester Steel Castings Co	30
Chicago Grain Door Co	17 and 30
Chicago Pneumatic Tool Co	15
Clayton Air Compressor Works	1
Cleveland City Forge & Iron Co	1
Cleveland Ship Building Co	46
Cleveland Twist Drill Co	1
Connelly, J. T	32
Coes Wrench Co	30
Continental Iron Works	5
Contractors' Plant Mfg. Co	5
Correspondence School of Technology	42
Crane Co	38
Crook, W. A., & Bros., Co	4
Crosby Steam Gage Valve Co	7
Devoe, F. W., & Co	1 and 23
D'Este & Seeley Co	2
Diamond Machine Co	32
Detroit Graphite Co	30
Detroit Lubricator Co	25
Dixon, Jos., Crucible Co	28 and 30
Dudgeon, Richard	5
Eureka Nut Lock Co	19
Ewald Iron Co	34
Faessler, J	34
Falls Hollow Staybolt Co	40
Felton, Sibley & Co	9
Ferracute Machine Co	9
Finished Steel Co	34
Fitchburg R. R. Co	34
Flint, Eddy & Co	27
Fowler, Geo. L	42
Fox Solid Pressed Steel Co	4
Galena Oil Works (Limited)	7
Gould Coupler Co	38
Gould & Eberhardt	18
Hale & Kilburn Mfg. Co	14
Hammett, M. C	30 and 46
Hancock Inspirator Co	26
Harlan & Hollingsworth Co	8
Harrington & King Perforating Co	1
Harland, W. M., & Sons	46
Hartford Woven Wire Mattress Co	7
Hartshorn, Stewart	16
Howard Iron Works	10
Howson & Howson	1
Hunt Co., C. W	19
Hutchins & Sons, C. B	46
Indian & Eastern Engr	40
Ingersoll-Sargeant Drill Co	27
International Correspondence Schools	23
Jackson, Sharp & Co	8
Jackson & Woodwin Mfg. Co	8
Jones & Lamson Machine Co	19
J. H. Bass	11
Keasbey & Mattison Co	2
Kelley Co	20
Keuffel & Esser Co	25
Krupp (Prosser & Son)	9 and 24
Laborers Inst. Pub. Co	16
Lake Shore & Mich. Southern Ry Co	38
Latrobe Steel Works	10
Leach, H. L	25
Lenoir Car Co	12
Lenoir Foundry Co	11
Leonard & Ellis	8
Leslie, J. S	20
Lehigh Valley Creosoting Works	8
Link-Belt Engineering Co	6
Lobdell Car Wheel Co	10
Long & Allstatter Co	46
Magnolia Metal Co	1
Manchester Locomotive Works	24
Mason, Volney W., & Co	15
McKeown, H. J	42
Merrill Bros	1
McConway & Torley Co	44
Mianus Electric Co	16
Moran Flex. Steam Joint Co. (Inc'd)	19
Morse Twist Drill Co	18
Moyes, L. M	6
Mundt & Sons, Chas	16
Mundy, J. S	4
National Hollow Brakebeam Co	22
National Malleable Castings Co	12
Nathan Mfg. Co	25
Newburgh Ice Machine & Engine Co	6
New York, N. Haven & Hartford R.R	40
Nolan, Thos	10
North Carolina Car Co	13
Norwalk Iron Works	36
Olsen, Tinius & Co	23
Page Woven Wire Fence Co	5
Pedrick & Ayer	28
Peerless Rubber Co	42
Pennsylvania R. R	38
Pennsylvania Steel Co	9
Phosphor Bronze Smelting Co	7
Photo Engraving Co	4
Pittsburgh Locomotive & Car Works	24
Pittsburgh Testing Laboratory, Ltd	22
Poole, R., & Son Co	3
Port Chester Bolt & Nut Co	22
Pratt & Whitney Co	20
Prosser, Thos., & Son	9 and 24
Prentiss Clock Improvement Co	34
Q. & C. Co	27
Queen & Crescent Route	32
Ramapo Wheel & Foundry Co	10
Rand Drill Co	32
Reliance Gauge Co	10
Rensselaer P. Institute	22
Richards, I. P	46
Richmond Locomotive & Machine Co	25
Riehle Bros. Testing Machine Co	5
Roberts Safety Water Tube Boiler	23
Rogers Locomotive Wks	24
Ross Valve Co	7
Russell Wheel and Foundry Co	1
Safety Car Heating & Lighting Co	13
Scarritt Furniture Co	14
Schenectady Locomotive Works	24
Schoen Pressed Steel Co	21
Scott, Chas., Spring Co	13
Sellers, William, & Co	2
Servoss, R. D	32
Shaw, Willis	8
Sheffield Car Co	1
Shoenberger Steel Co	46
Signal Oil Works	4
Sooysmith & Co	8
Standard Coupler Co	22
Sterling Emery Wheel Mfg. Co	18
Stow Mfg. Co	32
St. Louis Car Wheel Co	11
Thurman Fuel Oil Burner Co	32
Universal Protective Paint Co	—
U. S. Metallic Packing Co	3
Valentine & Co	46
Vanderbilt & Hopkins	32
Warren Chemical Mfg. Co	15
Warren & Co	42
Washington Patent Agency	9
Watson, H. F., Co	18
Watson & Stillman	5
Weber, F., & Co	19
Weir Frog Co	32
Wellington, Henry W	9
Wells Light	34
Westinghouse Air Brake Co	43
Woods, W. Dewees, Co	16
Worcester Machine Screw Co	9

RAILWAY CAR CONSTRUCTION,

By WILLIAM VOSS.

200 Pages. **Upward of 500 Engravings.** **Price, $3.**

AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL, Morse Building, New York.

H. S. BURKHARDT, President. E. B. LEIGH, V. P. and Gen. Man.

CHICAGO RAILWAY EQUIPMENT CO., Lessee.

A PERFECTLY CONSTRUCTED METAL BRAKE BEAM.
The Cheapest, Lightest and Most Durable.
Now Standard on a Large Number of Roads Throughout the Country.
CORRESPONDENCE SOLICITED.

General Office and Works:
40th and Hopkins Sts., Chicago.

CITY OFFICE: 514 Western Union Bldg., Chicago. NEW YORK OFFICE: Room 118, 29 Broadway. FREDERICK G. ELY, Eastern Agent.

POP VALVES and STEAM GAGES
MERITS AND REPUTATION
UNEQUALLED.
The Ashton Valve Co., Boston, Mass.

CAMBRIA STEEL.
Heavy Rails, Light Rails and Rail Fastenings, Street Rails, Steel Axles, Angles, Channels, Zee Bars, Beams, Bars, Castings, Forgings, Car Channels, etc. Address: **CAMBRIA IRON CO.**
S. W. Cor. 15th and Market Sts., Philadelphia, Pa.
(Opposite Pa. R. R. Station.)
[Works: Johnstown, Pa.]
Chicago Office, Western Union Building.
New York Offices—For Rails and Axles, 33 Wall St.
For Structural Steel, 100 Broadway.

Don't Hesitate to Write Us

In regard to Servis Tie Plates, Cold Sawing Machines, Car Door Equipment, Globe Ventilators,

Wood Preservatives, Oil Purifiers, Brake Slack Adjusters Etc, Delays are Dangerous Be Progressive.

The Q and C Company
Western Union Bldg.
Chicago Ill.

RAILWAY CAR CONSTRUCTION.

200 pages. 500 engravings. By WILLIAM VOSS.

With Full Working Drawings of Every Style of Car Now Used on American Railroads. Address

AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL, MORSE BUILDING, NEW YORK.

Rensselaer Polytechnic Institute, Troy, N.Y.
ESTABLISHED 1824.
A SCHOOL OF ENGINEERING
Local examinations provided for. Send for a Catalogue.

PITTSBURG TESTING LABORATORY, Limited.
GEO. H. CLAPP, Chairman. ALFRED E. HUNT, Vice-Chairman and Treas.
325 Water St., Pittsburg, Pa.
SPECIALTIES: Inspection of Rails and of Material for Bridges and other Structures, Steam Boilers, Locomotives, Cars, etc. Inspection of Shop Work and Erection at Bridge Site. Chemical Analysis and Physical Tests of all kinds.
Agens for Tinius, Olsen & Co.'s Testing Machines; Thacher' Slide Rules.

Port Chester Bolt and Nut Company,

PORT CHESTER, N. Y.
MANUFACTURERS OF
Cold Punched, Chamfered and Trimmed, Case Hardened, and Semi-Finished
NUTS.
Also BOLTS, RIVETS and WASHERS.
NUTS FOR RAILROADS, CAR BUILDERS', LOCOMOTIVE BUILDERS' AND MACHINISTS' USE A SPECIALTY.
Correspondence Solicited.

IMPROVED "STANDARD" COUPLER.
Manufactured by
GEO. A. POST, President.
A. P. DENNIS, Sec'y & Treas. STANDARD COUPLER CO., 26 Cortlandt St., N. Y.

FORGED STEEL KNUCKLE AND LOCKING PIN. Only Three Parts. No Pivot Pin.
SIMPLEST n DESIGN. STRONGEST in SERVICE. Thousands in Use. M. C. B. Type